DOE/NASA CONTRACTOR REPORT

DOE/NASA CR-161190

INSTALLATION PACKAGE FOR THE SOLARON SOLAR SUBSYSTEM

Prepared from documents furnished by

Solaron Corporation
4850 Olive Street
Commerce City, Colorado 80022

Under Contract NAS8-32249 with

National Aeronautics and Space Administration
George C. Marshall Space Flight Center, Alabama 35812

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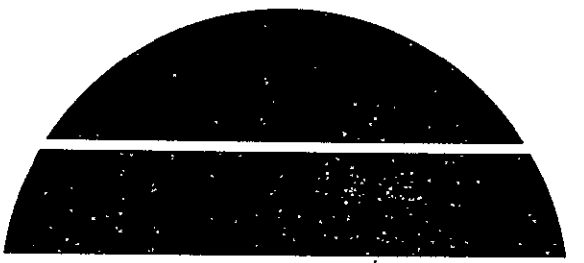

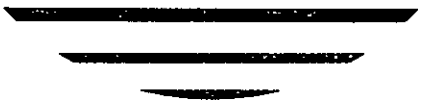

U.S. Department of Energy

Solar Energy

TECHNICAL REPORT STANDARD TITLE PAGE

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15. SUPPLEMENTARY NOTES

This work was done under the technical management of Mr. Ralph Cole, George C. Marshall Space Flight Center, Alabama.

16. ABSTRACT

This package contains information that is intended to be a guide for installation, operation, and maintenance of the various Solaron Solar Subsystems. The subsystems consist of the following: collectors, storage, transport (air handler) and controller for heat pump and off-peak storage.

Two prototype residential systems have been installed at Akron, Ohio, and Duffield, Virginia.

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	Unclassified-Unlimited William A. Brooksbank, Jr. WILLIAM A. BROOKSBANK, JR. Mgr, Solar Heating and Cooling Project Office

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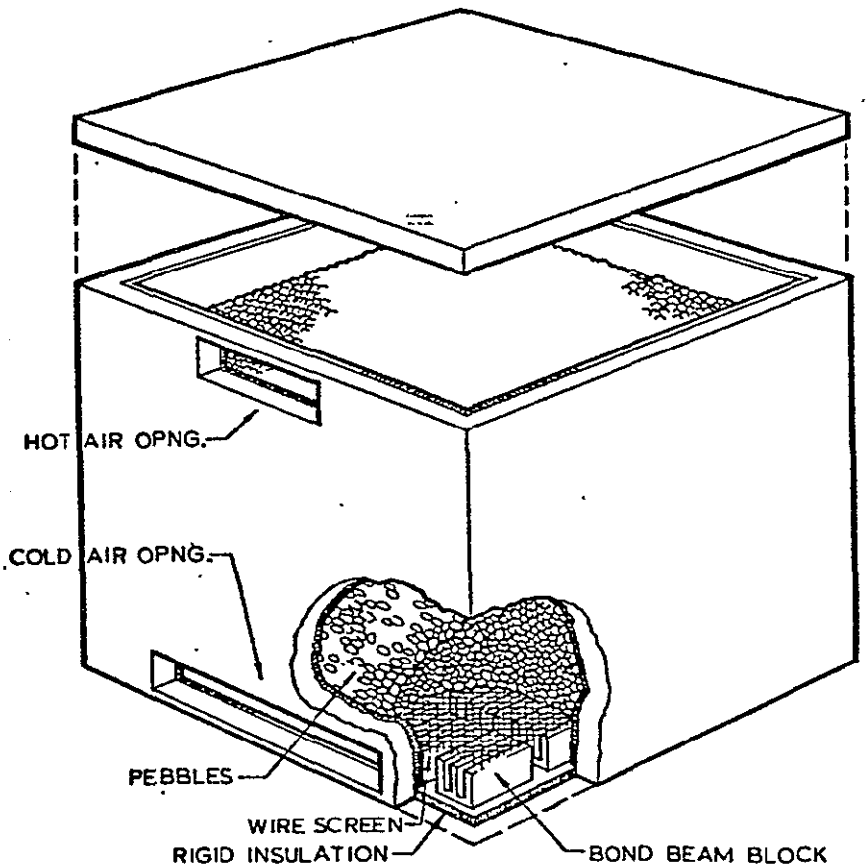
Installation, Operation, And Maintenance Manual

RESIDENTIAL HEAT STORAGE UNIT



SOLARON®
SOLAR ENERGY SYSTEMS

300 GALLERIA TOWER
720 SO. COLORADO BLVD.
DENVER, CO. 80222 (303) 759-0101

SOLARON
CORPORATION
Solar Energy Systems™

THIS MANUAL IS INTENDED TO BE USED ON PROJECTS WITH A MAXIMUM COLLECTOR AREA OF 540 SQUARE FEET.

TO THE READER:

THIS MANUAL IS INTENDED TO BE A GENERAL GUIDE FOR SIZING AND BUILDING THE HEAT STORAGE UNIT FOR A SOLARON SOLAR HEATING SYSTEM. THE STORAGE UNIT FOR SPECIFIC PROJECTS SHOULD BE CHECKED TO ENSURE IT IS DESIGNED AND BUILT PROPERLY TO ACCOUNT FOR ALL THE VARIABLES INVOLVED.

Due to our policy of continual improvement to our products, Solaron reserves the right to change the materials, installation procedures and specifications without notice.

Solaron assumes no responsibility for improperly designed or constructed heat storage units where this manual is used as a guide.

SOLARON CORPORATION 300 GALLERIA TOWER 720 SO COLORADO BLVD. DENVER. COLORADO 80222
PHONE 303/759-0101
TWX 910-931-2580

June 1, 1978

Solaron Corporation
300 Galleria Tower
720 S. Colorado Blvd.
Denver, Colorado 80222

Re: Solaron Installation Manual
Residential Heat Storage Unit

Gentlemen:

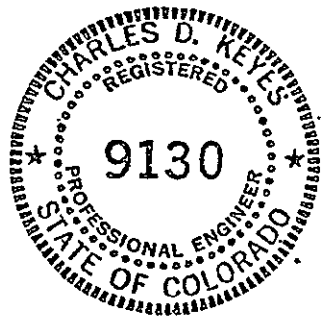
Structural details and specifications contained in this manual are derived from engineering analysis and design calculations done by KKBNA, Consulting Engineers. These calculations are based on strength of materials and performance criteria in accordance with latest design standards and specifications.

The structural drawings, material and installation specifications in this manual have been reviewed to check their conformance to the design calculations.

Sincerely,

KKBNA, Inc.

Charles D. Keyes
Vice President



CDK:et

DESCRIPTION

The use of pebbles in the heat storage unit is particularly effective with an air circulating solar heating system. The pebble bed maintains a high degree of temperature stratification (i.e., hot on top and cold on the bottom). This allows air to be provided at the highest available temperature to the heated space from the top of the pebble bed. It also allows air to return from the bottom of the bed to the collector at essentially room temperature, thus maximizing efficiency of solar heat collection and delivery.

The heat storage container can be constructed of any of the following materials:

a. Poured, reinforced concrete with a rigid fiberglass insulation inner liner (i.e., insulation is inside, separating the rock from the concrete wall).
b. Wood frame, plywood on 2 x 4 or 2 x 6 studs with a non-combustible inner liner suitable for temperatures as high as 200°F.

The heat storage unit should be built and installed by the local contractor to Solaron standard drawings and specifications. The air flow through the pebble bed must be vertical. Horizontal flow in pebble beds must be avoided due to channeling and "hot spot" problems.

It is important that the heat storage container be airtight and insulated as follows:

a. Storage unit inside a heated space: R-11 minimum.

b. Storage unit inside an unheated space: R-30 minimum.

c. Storage unit inside a heated space with wall in unheated area: R-30 minimum.

The heat storage unit can be conveniently placed in the basement or crawl space or set into the ground. Buried heat storage units must be waterproofed on all buried external surfaces (do not use asphalt or other sealers on inside walls). DO NOT bury heat storage unit below the high ground-water level due to possibility of water leakage into heat storage unit and resulting loss of performance. Support footings must be designed for local soil conditions. Due to the weight of the rocks, it should not be placed in the attic or on the upper floors without proper structural support. Typical floor loading with a rock depth of 5 feet is 500 pounds per square foot of floor area.

Design Criteria

Rock:
- Hard dense rock (i.e., density = 100 lbs./ft.^{3}, or greater).
- River gravel or hard, dense crushed rock is OK.
- Uniform size (i.e., most systems will use rock sized at 3/4" to 1-1/2" in diameter).
- Clean the rock before is is loaded in the storage box (i.e., wash it).
- Minimum of fines (i.e., 0 to 5%).

Storage:
- Airtight, insulated, structurally sound and, if buried, externally waterproofed. The inside surface materials must be able to withstand temperatures of approximately 200°F.

GENERAL NOTES

1. ANY SUBSTITUTION OF MATERIALS, CHANGES OF DIMENSIONS OR OTHER CHANGES IN HEAT STORAGE UNIT AS SHOWN MUST BE APPROVED BY SOLARON CORPORATION IN WRITING PRIOR TO START OF CONSTRUCTION.

2. ALL FOOTING AND STRUCTURAL SUPPORTS ARE THE RESPONSIBILITY OF OWNER AND/OR ARCHITECT AND SHALL BE SIZED ACCORDING TO SOIL REPORT INFORMATION. COORDINATE THIS DRAWING WITH ARCHITECTURAL DRAWINGS FOR TYPE, SIZE AND LOCATION OF FOOTING AND STRUCTURAL SUPPORTS.

3. JOINTS, CRACKS, SEAMS AND PENETRATIONS INSIDE AND OUT IN WALLS, FLOOR AND LID OF HEAT STORAGE UNIT SHALL BE SEALED AIR-TIGHT WITH DOW CORNING #732 SILICONE SEALANT CAULK OR APPROVED EQUAL.

4. BOND BEAM BLOCK - 2 OR 3 WEB. WEBS MUST BE AT A RIGHT ANGLE TO WALL CONTAINING BOTTOM OPENING (SEE DETAIL FOR TRANSITE DUCT AND BOND BEAM BLOCK ORIENTATION).

5. METAL LATH - USE JR. DIAMOND MESH 3.4 LB./SQ. YD. (GALVANIZED) ADJOINING PIECES TO BE OVERLAPPED A MINIMUM OF 6". TURN EDGE UP ONTO INNER WALLS OF HEAT STORAGE UNIT A MINIMUM OF 12".

6. THE ROCK SHALL BE ROUND WASHED RIVER ROCK OR STONE. 95% OF THE ROCK SHALL BE THE SIZE SHOWN ON THE PLANS WITH A MINIMUM AMOUNT OF FINES (I.E., LESS THAN 1/4" DIAMETER). THE ROCK SHALL BE CLEAN AND FREE OF DIRT. NORMALLY THE ROCK IS SIZED BY SCREENING (THAT ROCK WHICH PASSES THROUGH A 1-1/2" SCREEN BUT NOT A 3/4" SCREEN IS THE NORMAL SIZE).

7. TREATMENT FOR THE INSIDE SURFACES OF THE BOX SHALL BE SUITABLE FOR TEMPERATURES OF 200°F. NO COMBUSTIBLE MATERIAL WILL BE USED.

8. NON-LOAD BEARING LID SHALL BE CONSTRUCTED OF 1/2" EXTERIOR GRADE PLYWOOD INSIDE AND OUT--2 x 4'S - 24" ON CENTER AND 1/2" MOISTURE-RESISTANT TYPE "X" DRYWALL ON INSIDE SURFACE TOWARD PEBBLES. 28-GAUGE SHEET METAL CAN BE USED IN LIEU OF DRYWALL.

9. LOAD BEARING LID SHALL BE CONSTRUCTED OF 1/2" EXTERIOR GRADE PLYWOOD INSIDE AND OUT--2 x 6'S - 24" ON CENTER AND 1/2" MOISTURE-RESISTANT TYPE "X" DRYWALL ON INSIDE SURFACE TOWARD PEBBLES. 28-GAUGE SHEET METAL CAN BE USED IN LIEU OF DRYWALL.

HEAT STORAGE UNIT DESIGN PARAMETERS		
DESIGN TEMPERATURE TOP AND BOTTOM	PRESSURES	AIR FLOW
MAXIMUM TEMPERATURE (200°F)	ENTIRE STORAGE UNIT	THRU ROCK 20 TO 40 FPM
OPERATING RANGE (90° TO 180°)	ATMOSPHERIC PRESSURE ±3" W. C.	THRU OPENINGS 800 TO 1000 FPM
MINIMUM TEMPERATURE (AMBIENT)		

GENERAL NOTES

(Continued)

9. CONCRETE:

   A. ALL CONCRETE SHALL ATTAIN 3,000 PSI ULTIMATE COMPRESSIVE STRENGTH IN 28 DAYS.

   B. ALL REINFORCING SHALL BE HIGH STRENGTH DEFORMED BARS ASTM DESIGNATION A615, GRADE 40 OR GRADE 60.

10. STEEL:

    ALL STRUCTURAL STEEL SHALL CONFORM TO ASTM SPECIFICATION A36.

11. MASONRY:

    A. ALL MORTAR SHALL DEVELOP 1,800 PSI ULTIMATE COMPRESSIVE STRENGTH IN 28 DAYS.

    B. ALL MASONRY SHALL DEVELOP 1,500 PSI ULTIMATE COMPRESSIVE STRENGTH IN 28 DAYS.

    C. ALL REINFORCING SHALL CONFORM TO ASTM 615, GRADE 40 OR GRADE 60.

12. WOOD:

    A. ALL FRAMING LUMBER SHALL BE DRY HEM-FIR GRADE 2.

    B. ALL PLYWOOD SHALL BE OF THICKNESS SPECIFIED C-C EXT DFPA OR BETTER. NAILED TO SUPPORTS WITH 10d NAILS SPACED 6" O.C. AT PANEL EDGES AND SPACED 12" O.C. AT ALL OTHER SUPPORTS. PLYWOOD SHALL BE APPLIED WITH FACE GRAIN PERPENDICULAR TO SUPPORTS.

13. TRANSITE DUCT:

    TRANSITE DUCT CAN BE USED INSTEAD OF THE EXTERNAL BOTTOM DUCT OPENING TO ALLOW AIR FLOW TO AND FROM THE BOTTOM OF THE HEAT STORAGE UNIT WITHOUT PENETRATING THE UNIT OR RUNNING AN EXTERNAL DUCT. EXAMPLE: WHEN MECHANICAL EQUIPMENT IS INSTALLED ON TOP OF THE HEAT STORAGE UNIT OR WHEN THE HEAT STORAGE UNIT IS BURIED.

ONE 8" DIAMETER DUCT SERVES 53 CU. FT. OF STORAGE AT 210 CFM.
ONE 10" DIAMETER DUCT SERVES 95 CU. FT. OF STORAGE AT 380 CFM.
ONE 12" DIAMETER DUCT SERVES 150 CU. FT. OF STORAGE AT 600 CFM.
ONE 14" DIAMETER DUCT SERVES 225 CU. FT. OF STORAGE AT 900 CFM.
ONE 16" DIAMETER DUCT SERVES 270 CU. FT. OF STORAGE AT 1,080 CFM.

HEAT STORAGE UNIT AND ROCK SIZING SHEET

a. VOLUME: Storage size is determined from the collector area. 3/8 $ft.^3$ to 1/2 $ft.^3$ of rock is required per $ft.^2$ of collector area.

Collector Area = _____ $ft.^2$

Volume = (_____ $ft.^3/ft.^2$)(_____ $ft.^2$ collector) = ... | _____ $ft.^3$

(_____ $ft.^3$)(100 lbs./$ft.^3$)(1 ton/2,000 lbs.) = ... | _____ tons

(_____ $ft.^3$) ÷ 27 $ft.^3$/cu. yd. = ... | _____ cu. yds.

b. DIMENSIONS:

(_____ $ft.^3$) ÷ (_____* ft. rock depth) = ... | _____ $ft.^2$ floor area

Storage unit inside dimensions = _____ ft. long x _____ ft. wide

Minimum dimension of 3' for length or width
Maximum dimension of 7' for length or width. For larger dimensions, see commercial manual for structure required.

c. ROCK SIZE: (see chart below)

(_____ cfm) ÷ (_____ $ft.^2$ floor area) = ... | _____ fpm

_____ fpm } = 3/4"-1-1/2" Ø rock and _____" w.g. static pressure drop thru rock
_____ ft. rock depth }

d. AIR INLET/OUTLET SIZES: Size duct connections at 800 to 1,000 fpm

Top: _____" high x _____" wide

Bottom: 8 " high x _____" wide

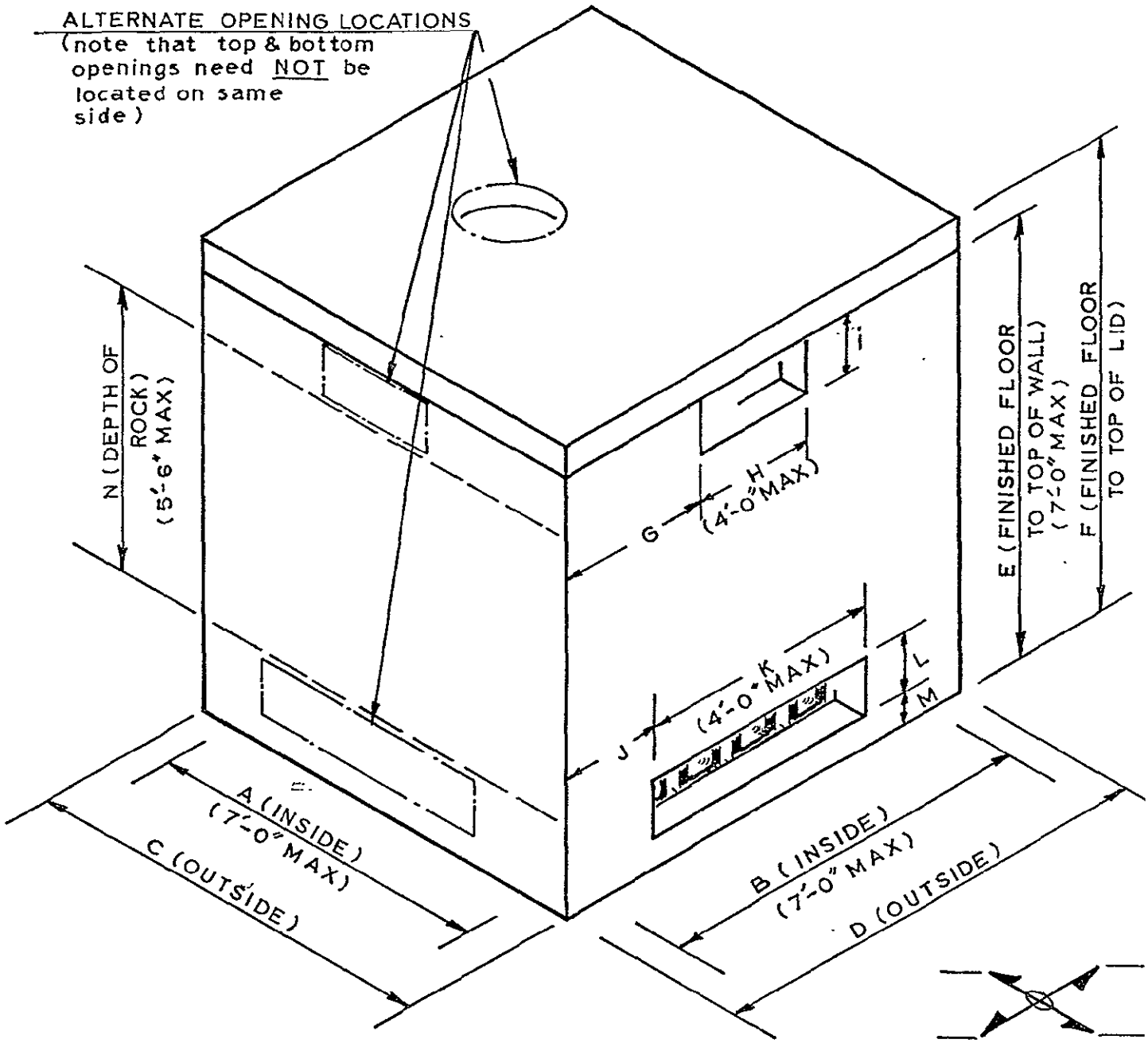
(NOTE: Bottom opening must always be at least twice as wide as top opening to account for restriction caused by bond beam block. Optional top opening as per pages 6 and 13.)

The following data should be used to determine the proper combinations of rock size and rock depth. Minimum allow. static pressure loss 0.12" w.g.

STATIC PRESSURE LOSS THRU PEBBLE BED STORAGE UNIT (INCHES W.G.)				
FACE VELOCITY ACROSS ROCK BOX →		20 FPM	25 FPM	30 FPM
ROCK DEPTH-FEET	ROCK SIZE			
4-1/2'	3/4" to 1-1/2"	0.12"	0.22"	0.31"
5'	3/4" to 1-1/2"	0.14"	0.23"	0.34"
5-1/2'	3/4" to 1-1/2"	0.16"	0.24"	0.37"

* 5'6" maximum depth for residential unit; 4'6" minimum rock depth.

HEAT STORAGE UNIT SIZING



_____ TONS OF ROCK (100 lbs. per CU. FT.)

_____ CU. FT. ROCK (A x B x N)

DIMENSIONS					
A		F		K	
B		G		L	8"
C		H		M	
D		I		N	
E		J			

NOTE: 14" x 14" high sidewall opening location can be used when air handler outlet is mounted directly to box.

RESIDENTIAL HEAT STORAGE UNIT

CONCRETE CONSTRUCTION

1. WALL CONSTRUCTION TO BE 6" MINIMUM REINFORCED CONCRETE (8" PREFERRED). VERTICAL AND HORIZONTAL RE-BAR:

   A. 2 - #5 RE-BAR TOP AND BOTTOM CONTINUOUS.

   B. #4 RE-BAR @ 18" O.C. VERTICAL IN OUTSIDE FACE.

   C. #4 RE-BAR @ 12" O.C. HORIZONTALLY FOR 6" THICK WALLS.

      #4 RE-BAR @ 10" O.C. HORIZONTALLY FOR 8" THICK WALLS.

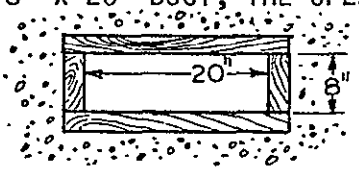
   D. DOWEL WALL TO FLOOR WITH ONE OF FOLLOWING:

      1. #4 RE-BAR "L" 1'6" x 1'6" @ 18" O.C.
         OR
      2. 1/2" Ø x 8" HEADED ANCHOR BOLT W/NUT @ 18" O.C.
         OR
      3. 1/2" Ø EXPANSION ANCHOR W/5" BOLT @ 18" O.C.

      CENTER ANY OF THE OPTIONS ON WALL.

2. FORM OUT FOR BOTTOM AND TOP OPENINGS AS REQUIRED FOR A GIVEN APPLICATION WITH 2 X DIMENSION LUMBER WHICH SHOULD BE LEFT INTACT WHEN FORMS ARE REMOVED TO PROVIDE MOUNTING FRAME FOR DUCTWORK. PLACE 2 #5 RE-BARS (1 ON EACH FACE) WITH 2'-0" PROJECTION AROUND ALL OPENINGS IN CONCRETE. PROTECT WOOD FRAMING FROM AIRSTREAM WITH SHEET METAL COLLAR OR GYP BOARD. THE FINISHED FRAMED INSIDE DIMENSION SHOULD BE THE SAME SIZE AS THE DUCT. SEE EXAMPLE BELOW:

   EXAMPLE: FOR AN 8" x 20" DUCT, THE OPENING SHOULD BE

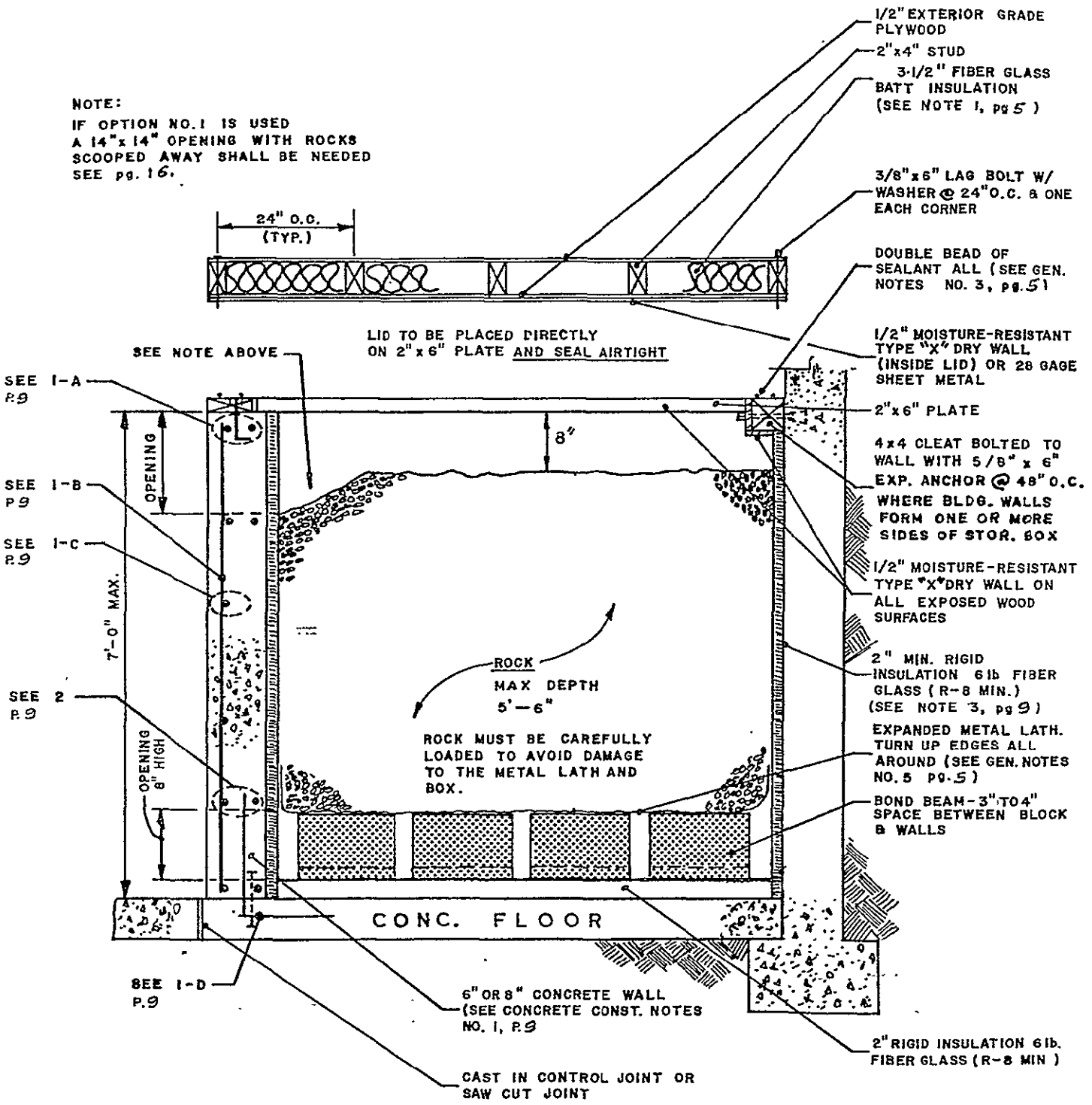


3. INSULATE INTERIOR SURFACE WITH 2" RIGID FIBERGLASS BOARD INSULATION (6 LB. DENSITY WITH R-8 MINIMUM), "CERTAIN-TEED" #IB600, 2" PLAIN. SECURE TO WALL. DO NOT USE STYROFOAM OR URETHANE INSULATION ON INTERIOR WALLS OF STORAGE UNIT.

4. MAXIMUM INSIDE FLOOR DIMENSIONS: 7' x 7'.

5. INSTALLATION REQUIRED TO COMPLY WITH ALL APPLICABLE NATIONAL AND LOCAL BUILDING CODES.

RESIDENTIAL
HEAT STORAGE UNIT
CONCRETE



NOTE: R-11 MIN. (R-30 IN UNHEATED AREA)

NOTE: INTERIOR SURFACES AND INSULATION OF ROCK BOX MUST BE NON-COMBUSTIBLE AND SUITABLE FOR TEMPERATURES UP TO 200° F.

RESIDENTIAL HEAT STORAGE UNIT

WOOD CONSTRUCTION

1. WALL CONSTRUCTION TO BE SINGLE 2 X 4'S NAILED VERTICALLY 16" O.C. (NO TOE NAILING). VERTICAL 2 X 4'S @ CORNER TO BE NAILED. A DOUBLE 2 X 4 HORIZONTAL BEAM WILL BE NAILED IN (USING 'SIMPSON' LU 24 JOIST HANGER @ EACH VERT. STUD) 2' - 9" FROM FLOOR ALL AROUND. THE INLET AND OUTLET OPENING TO BE FRAMED WITH 2 X 4 BLOCKING; OUTSIDE DRYWALL SHEATING TO BE INSTALLED AFTER WALL FRAMING IS SET, ANCHORED AND INSULATED. INSIDE SHEATHING TO BE 1/2" EXTERIOR GRADE PLYWOOD OVERLAID WITH 1/2" TYPE X DRYWALL (ALL SEAMS TO BE CAULKED WITH DOW CORNING 732 SILICONE SEALANT. 28 GA. SHEET METAL MAY BE SUBSTITUTED FOR THE DRYWALL. ROCK BOX MUST BE AIRTIGHT.

2. INSULATE ALL VOIDS WITH 3" TO 3-1/2" FIBERGLASS BATT INSULATING (R-11 MINIMUM). ADDITIONAL INSULATION REQUIRED WHEN PEBBLE BED IS LOCATED IN AN UNHEATED SPACE (R-30 MINIMUM). DO NOT USE STYROFOAM OR URETHANE INSULATION AS BED INNER LINER.

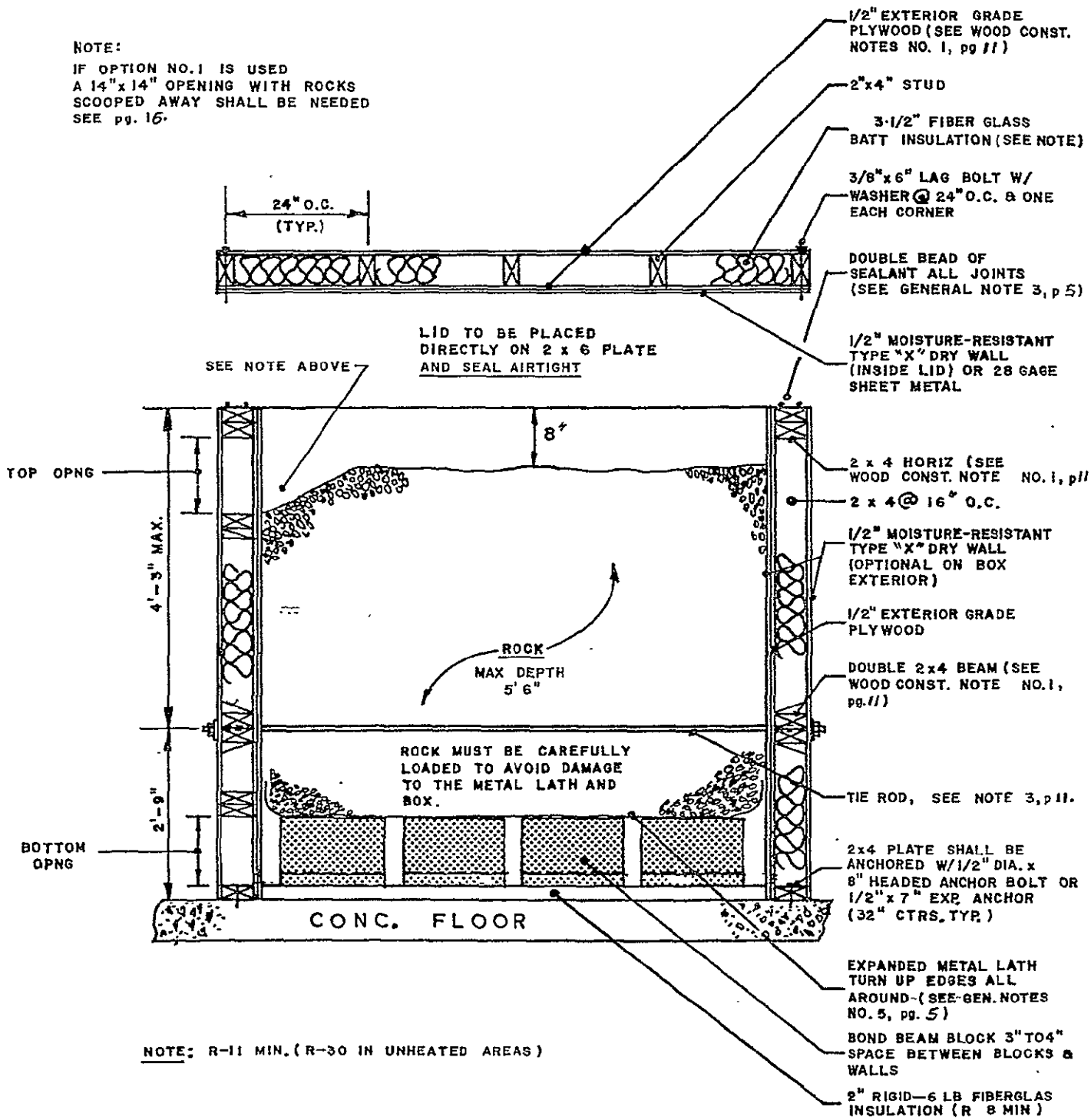
3. TWO TENSIONS RODS TO MINIMIZE THE BOWING OF THE CENTER OF THE WALLS SHALL BE STEEL TIE RODS, 1/2" DIA. WITH 1/4" X 3" X 3" FLAT PLATE WASHERS AND NUTS AT EACH END. PRETENSION RODS UNTIL WALL CENTERS HAVE CONCAVED INWARD APPROXIMATELY 1/8" BEFORE APPLYING SEALANT TO JOINTS.

4. SUBSTITUTION OF 2" X 6" FOR 2" X 4" ARE SATISFACTORY IF INSULATION VALUE OF R-19 IS DESIRED FOR WALL SECTIONS.

5. MAXIMUM INSIDE FLOOR DIMENSIONS: 7' X 7'.

6. INSTALLATION REQUIRED TO COMPLY WITH ALL APPLICABLE NATIONAL AND LOCAL BUILDING CODES.

RESIDENTIAL
HEAT STORAGE UNIT
WOOD

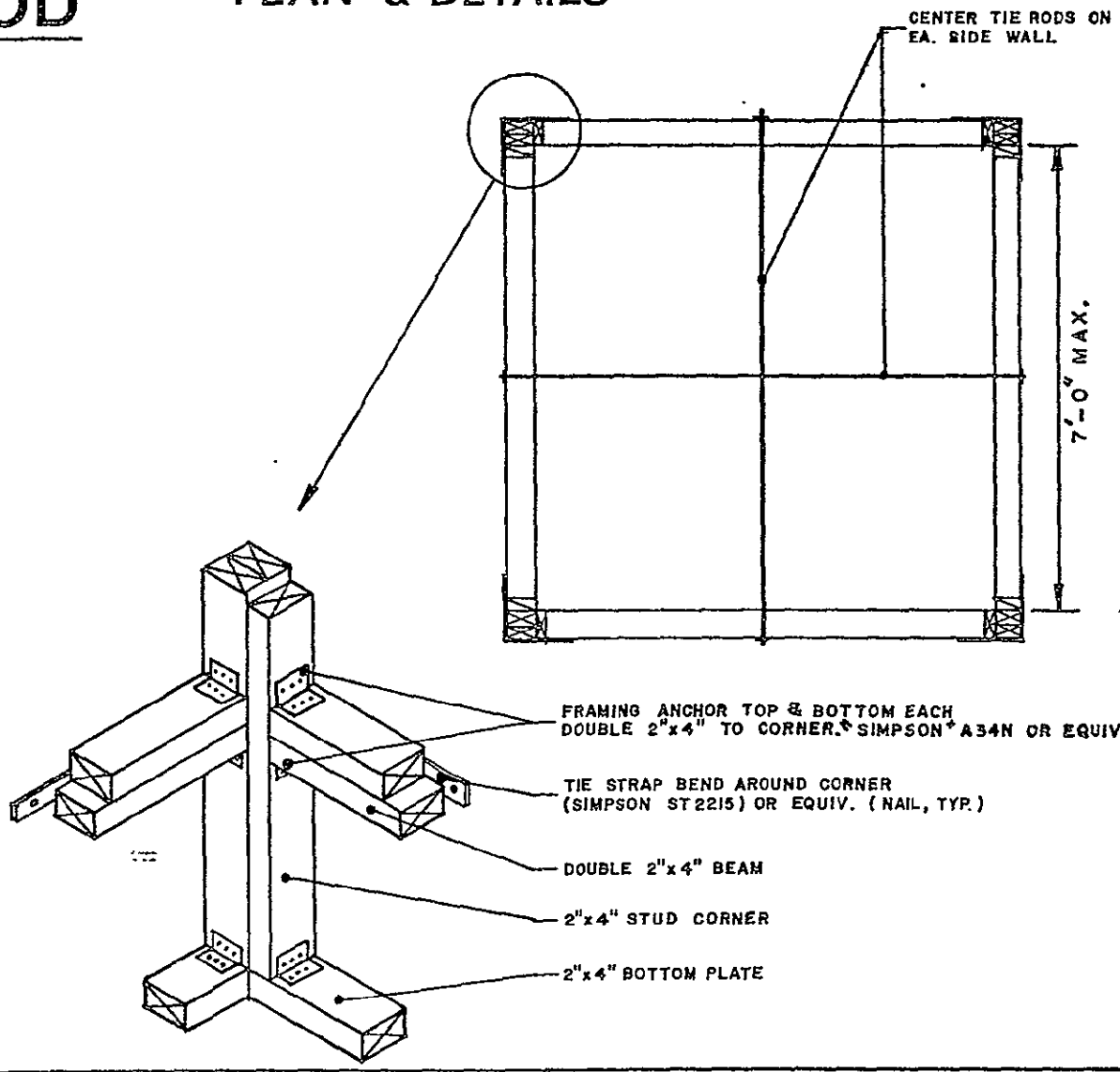


NOTE: R-11 MIN. (R-30 IN UNHEATED AREAS)

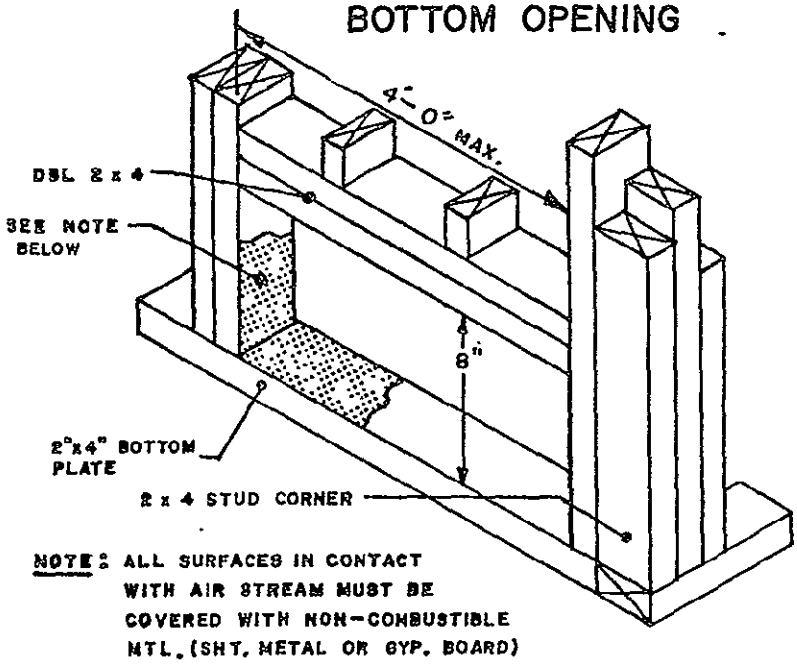
NOTE: INTERIOR SURFACES AND INSULATION OF ROCK BOX MUST BE NON-COMBUSTIBLE AND SUITABLE FOR TEMPERATURES UP TO 200° F.

RESIDENTIAL HEAT STORAGE UNIT

WOOD PLAN & DETAILS

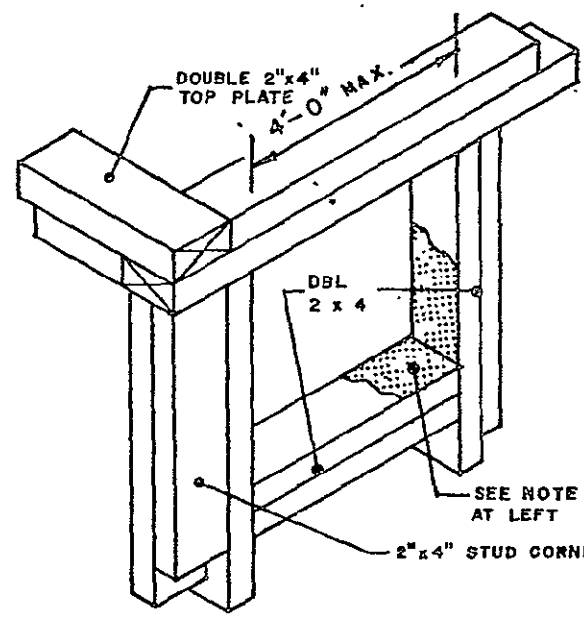


BOTTOM OPENING



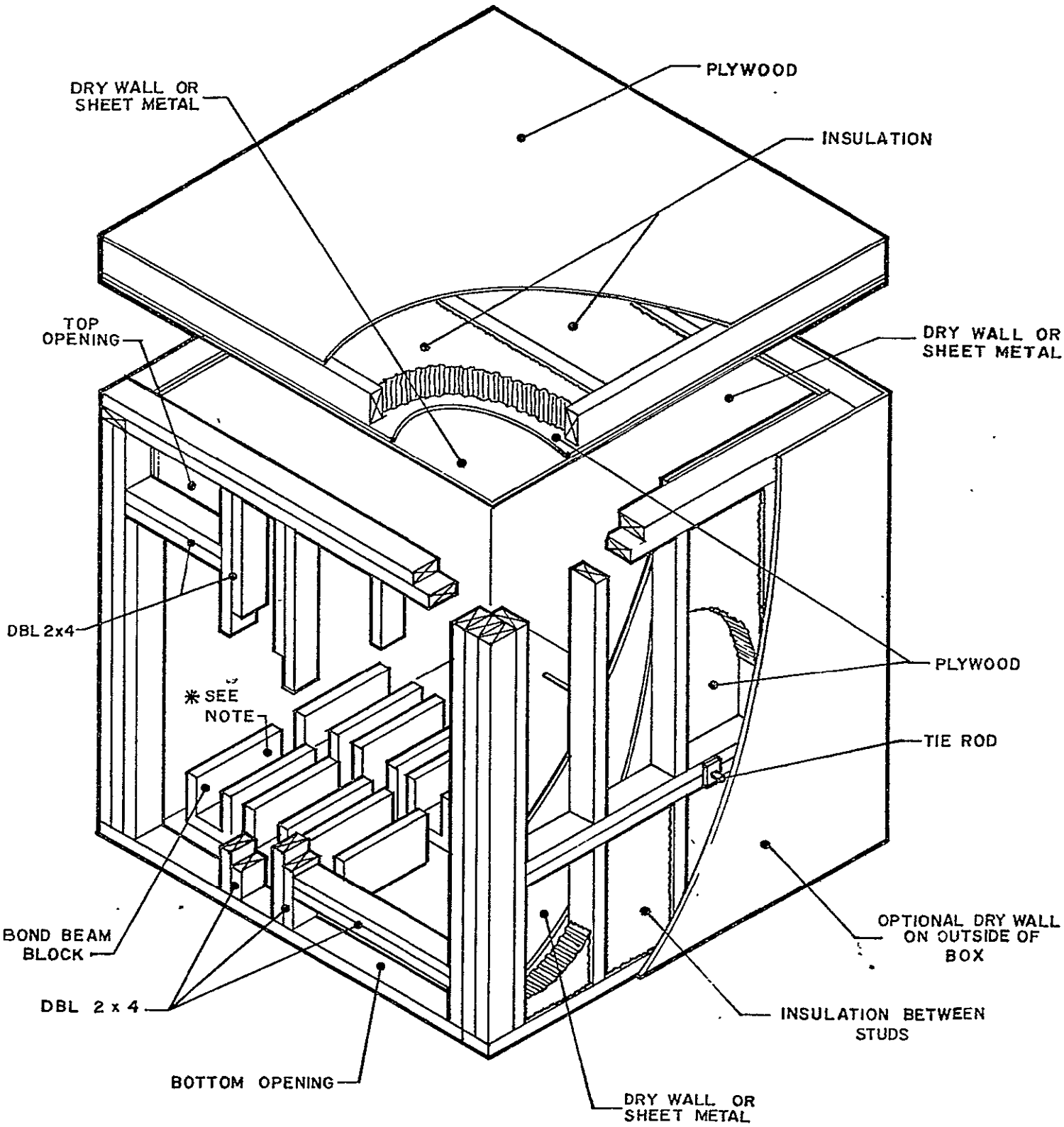
NOTE: ALL SURFACES IN CONTACT WITH AIR STREAM MUST BE COVERED WITH NON-COMBUSTIBLE MTL. (SHT. METAL OR GYP. BOARD)

TOP OPENING



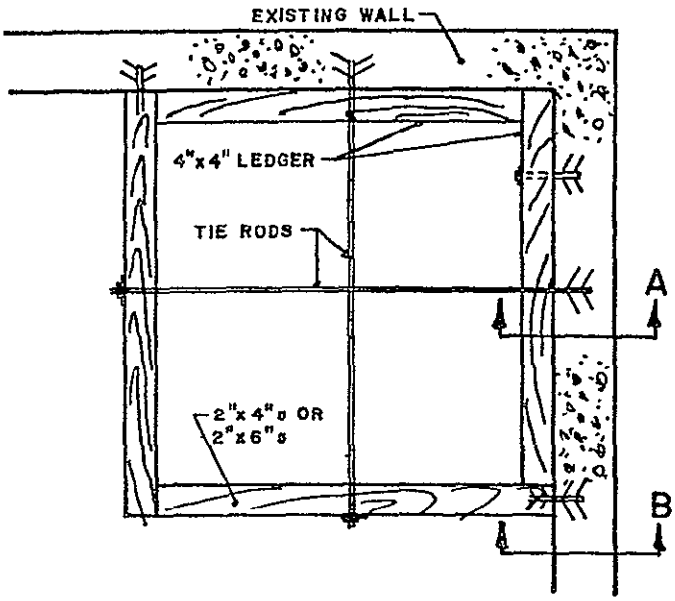
RESIDENTIAL HEAT STORAGE UNIT

WOOD

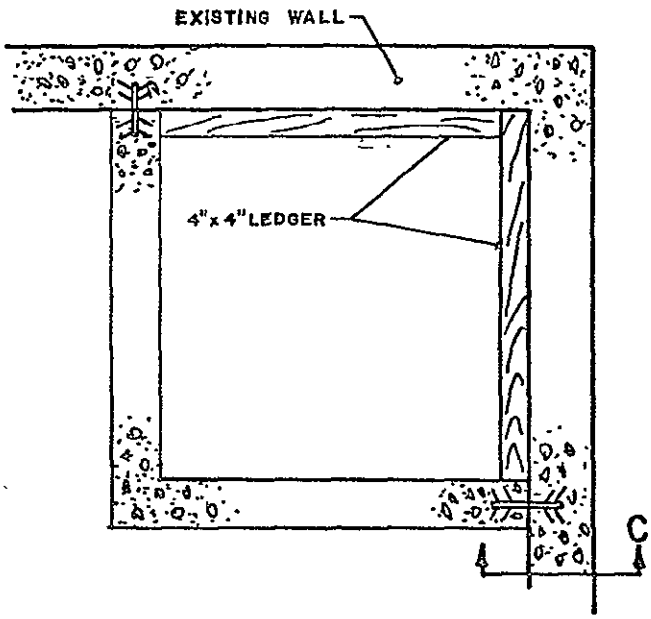


NOTE: BOND BEAM BLOCK MUST BE PERPENDICULAR TO WALL CONTAINING BOTTOM OPENING

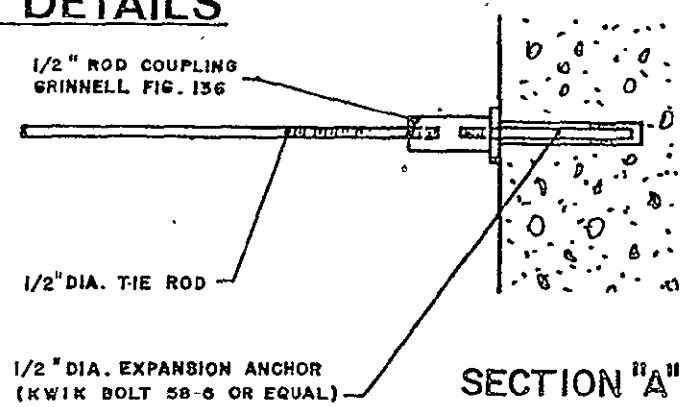
RESIDENTIAL HEAT STORAGE UNIT
ATTACHMENT DETAILS



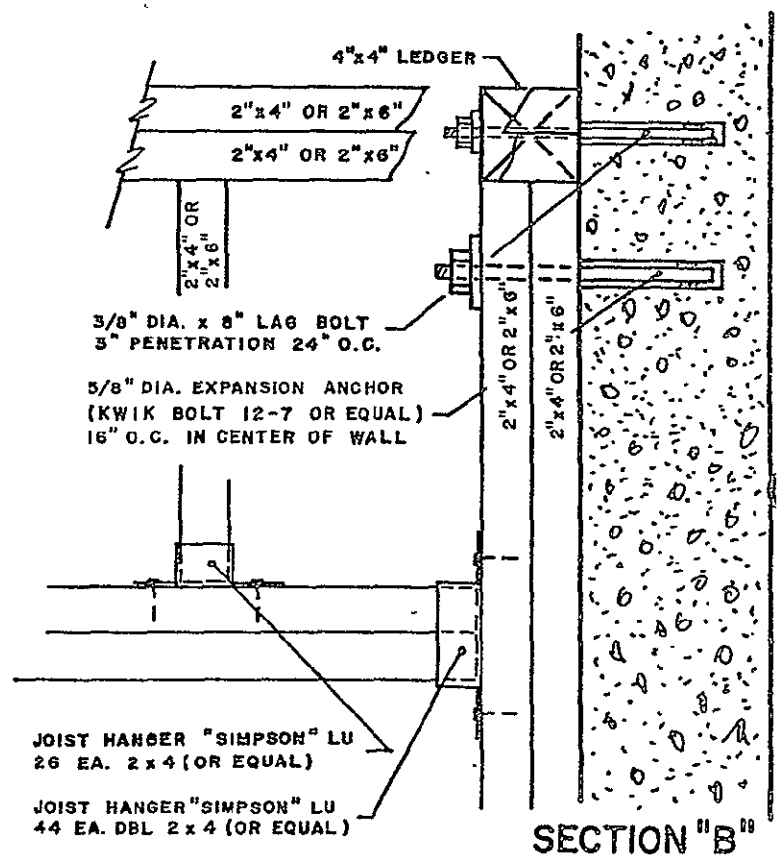
WOOD CONSTRUCTION PLAN



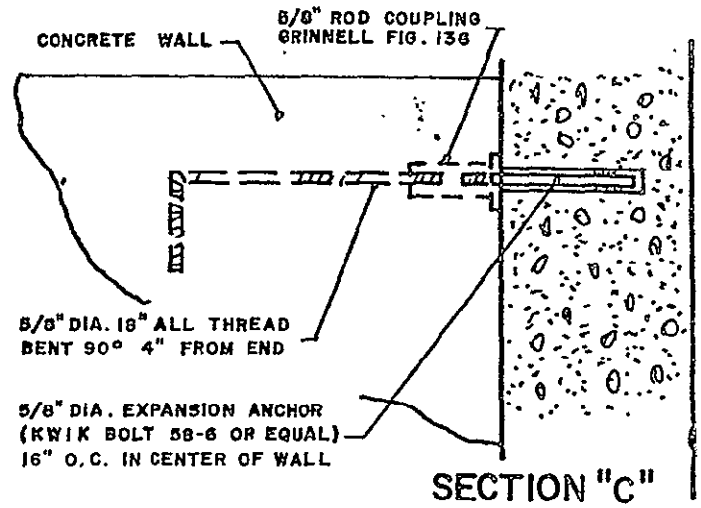
CONCRETE CONSTRUCTION PLAN



SECTION "A"



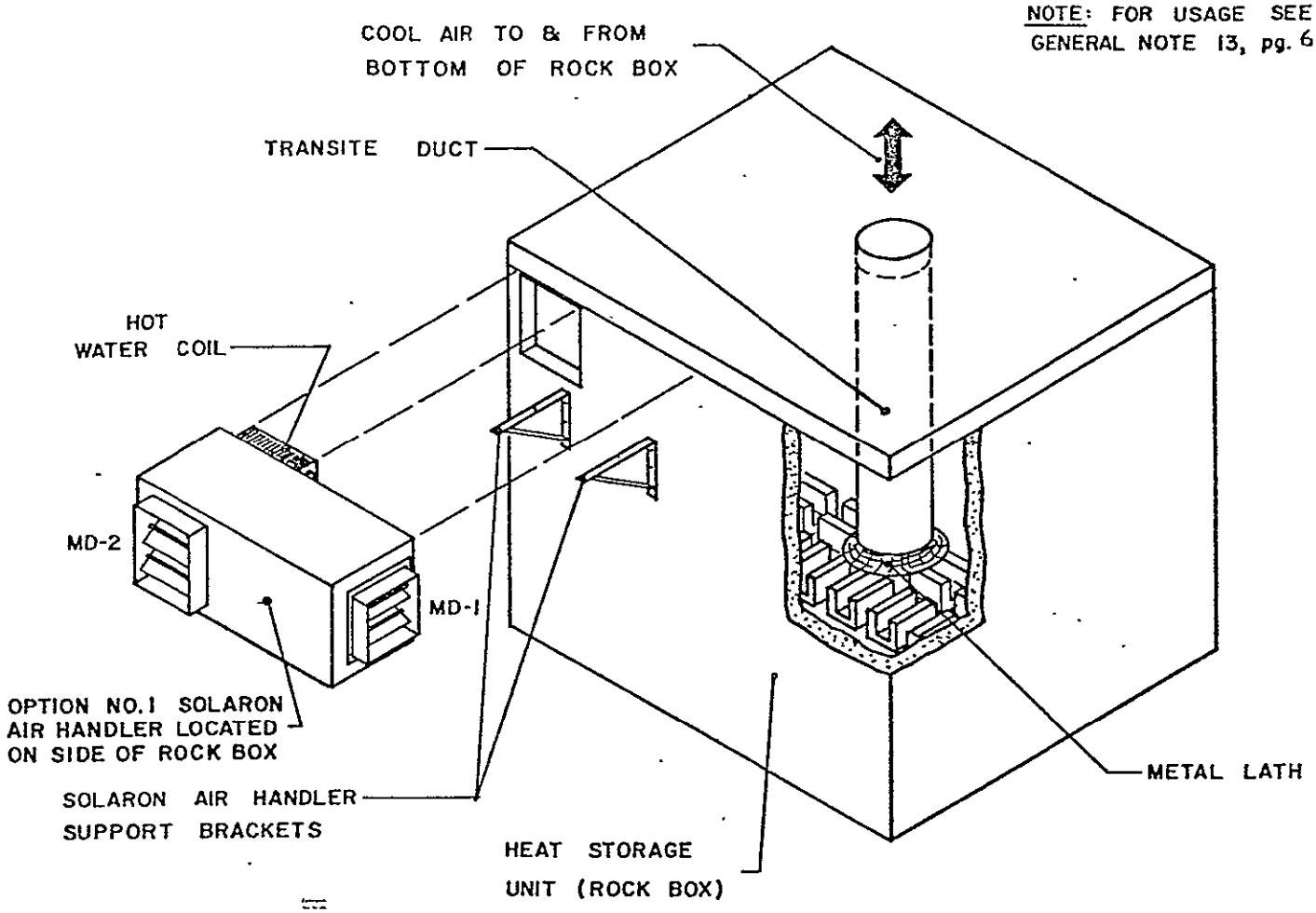
SECTION "B"

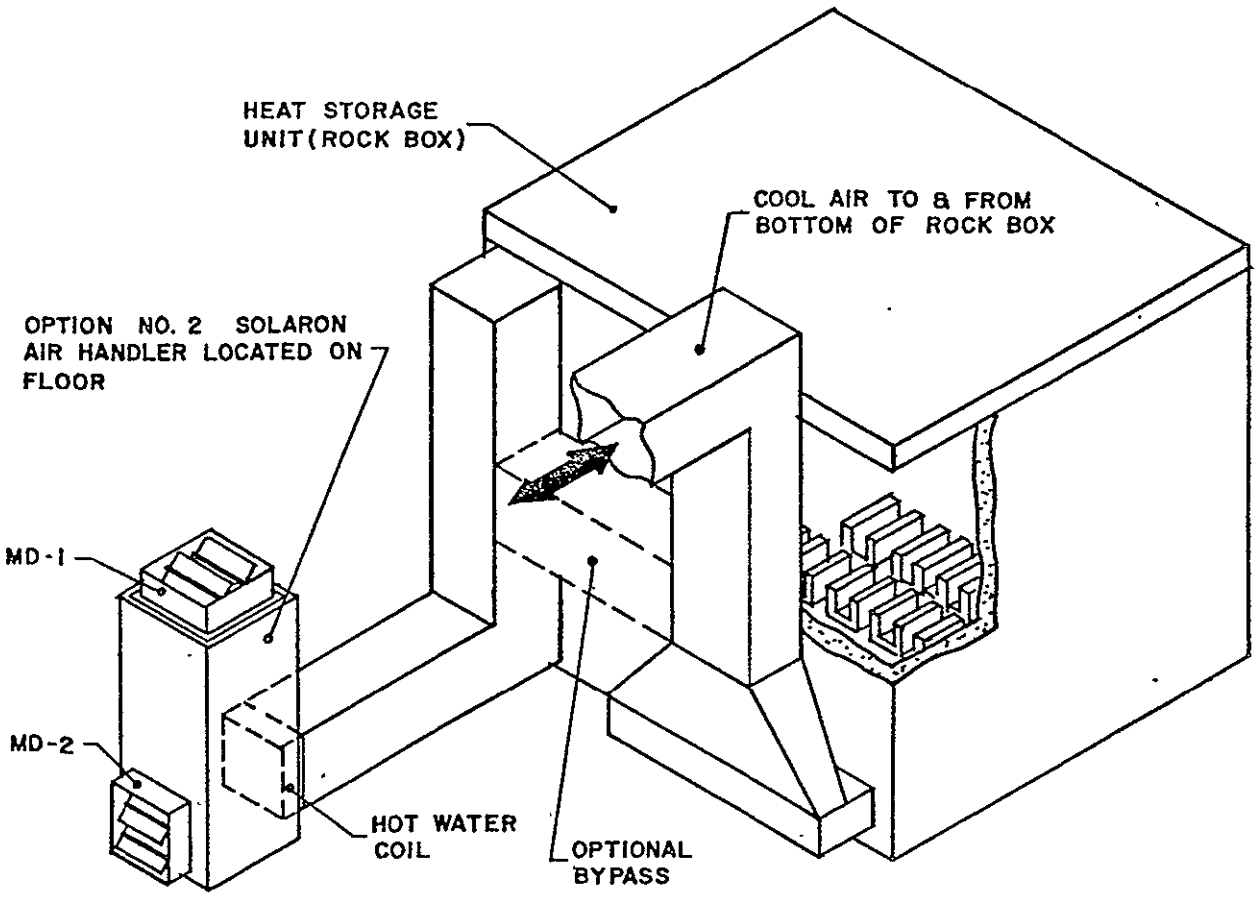


SECTION "C"

OPTIONAL AIR HANDLER & DUCT LOCATIONS

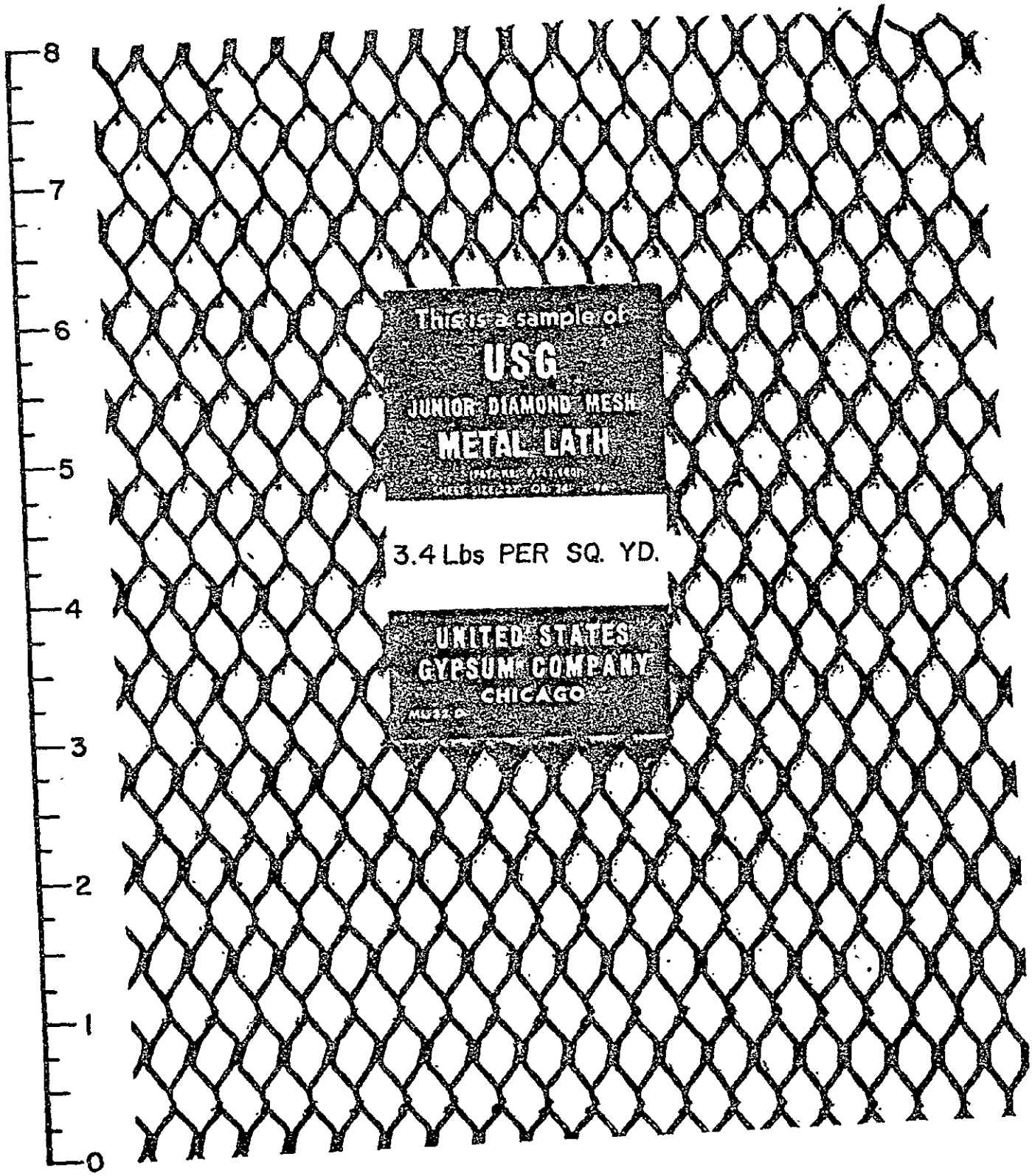
NOTE: FOR USAGE SEE GENERAL NOTE 13, pg. 6-



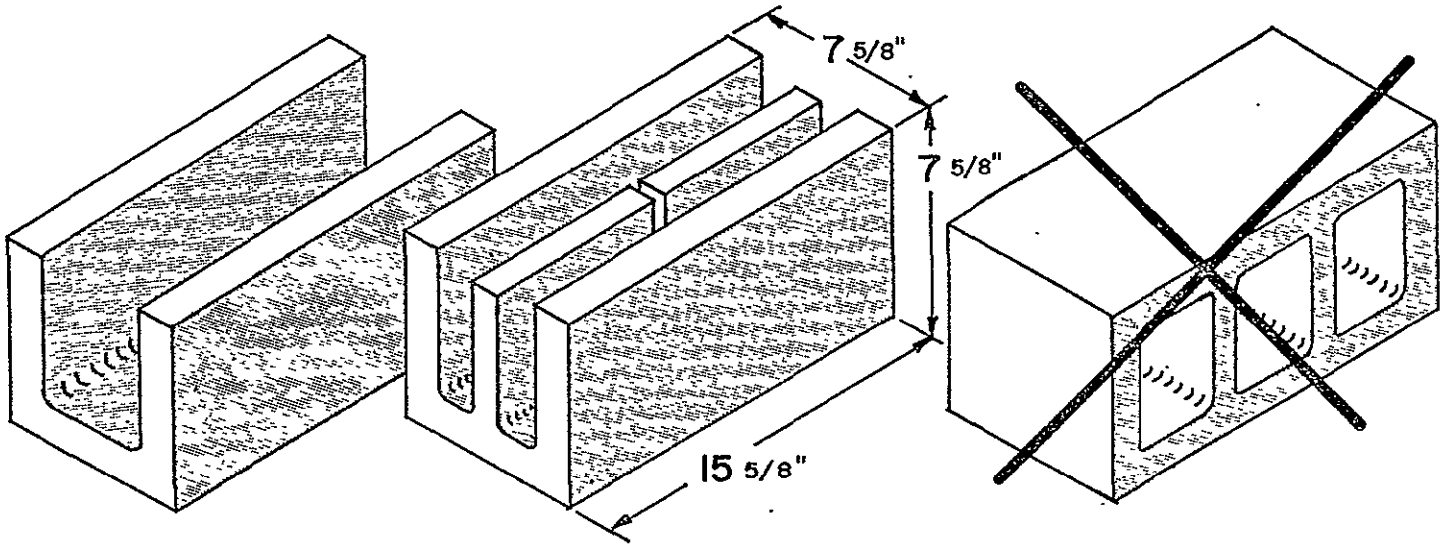


METAL LATH SAMPLE

(MUST BE GALVANIZED)

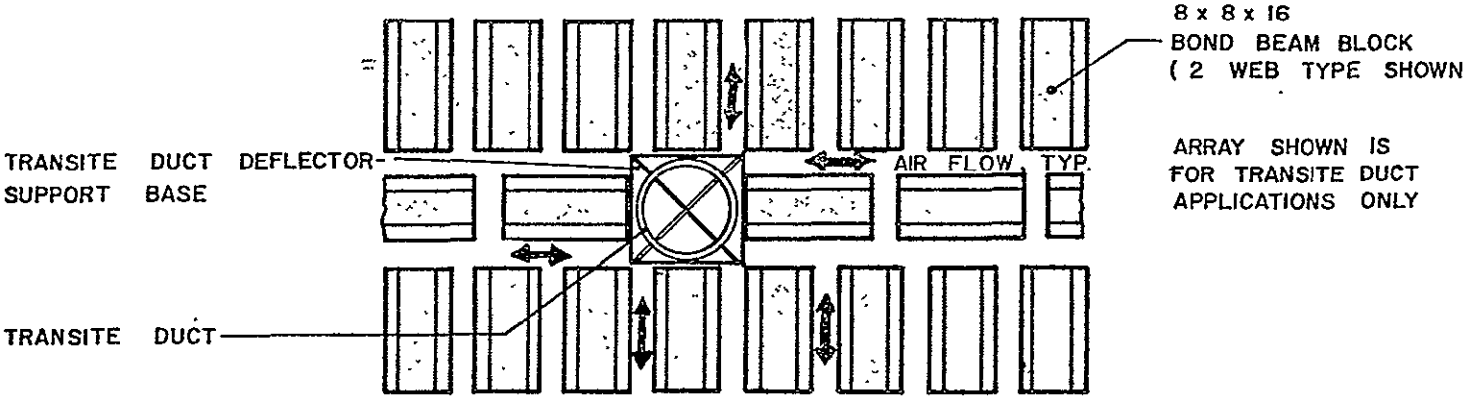


BOND BEAM BLOCK & TRANSITE DUCT DETAILS

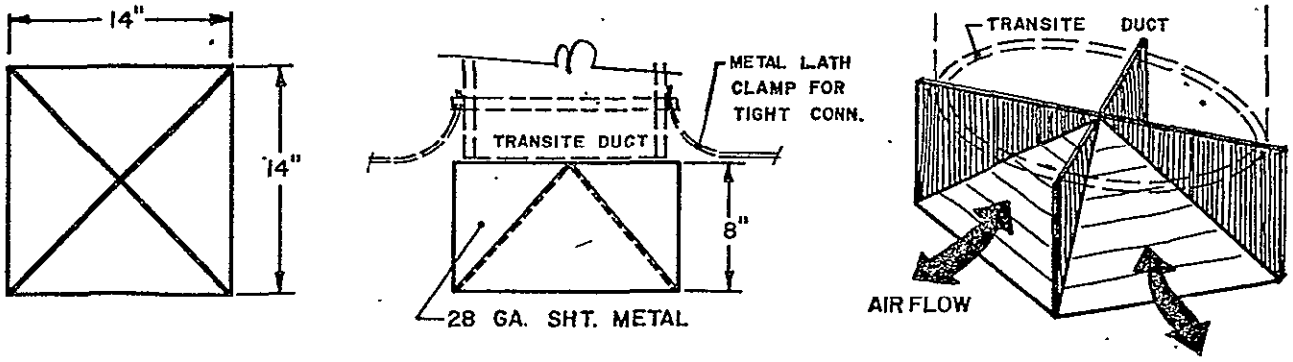


2 WEB 3 WEB DO NOT USE

BOND BEAM BLOCK STANDARD BLOCK



BOND BEAM BLOCK ARRAY - PLAN VIEW



TOP SIDE ISOMETRIC

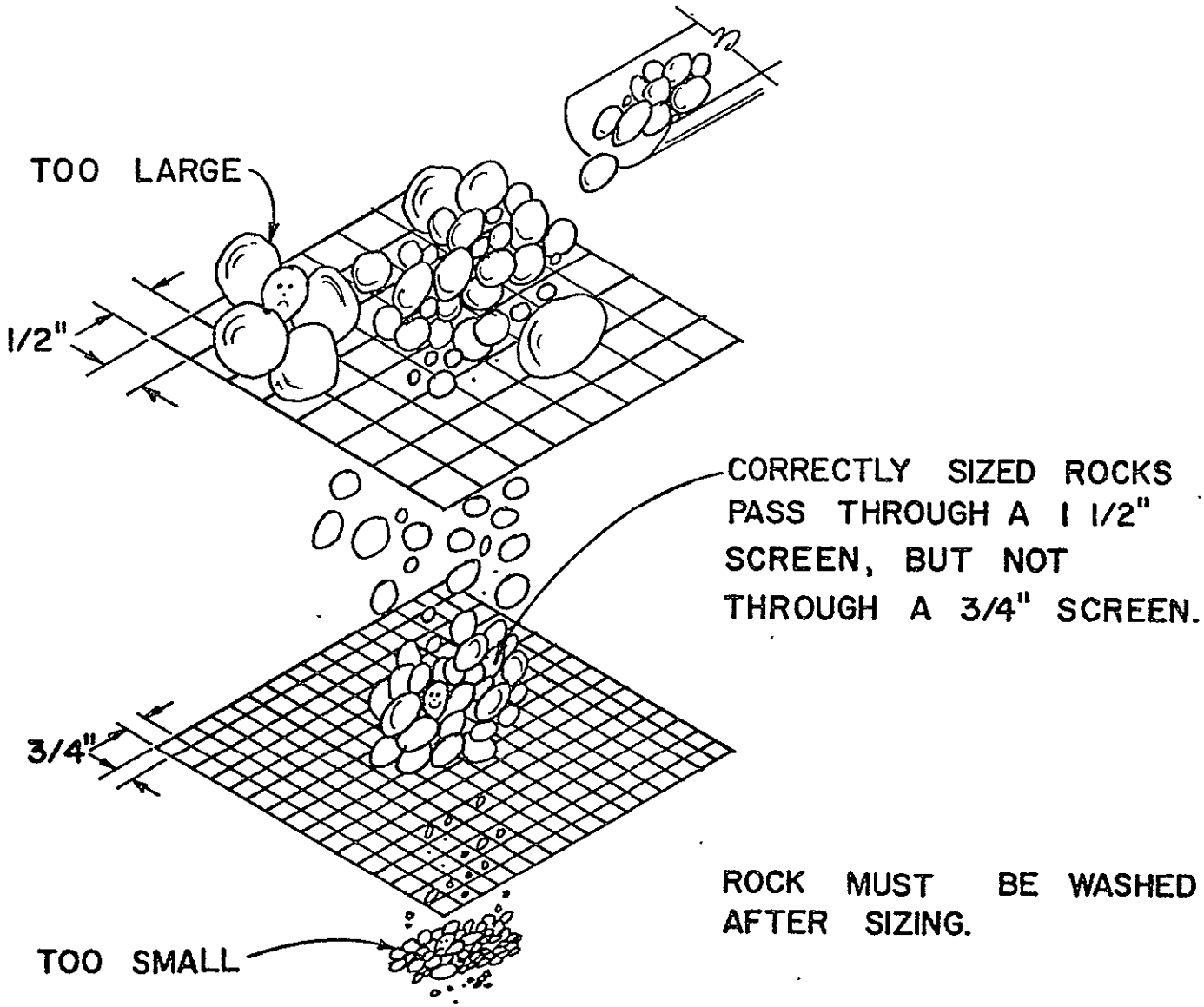
TRANSITE DUCT DEFLECTOR - SUPPORT BASE

ROCK & SIZING METHOD

ANY ROCK USED IN THE HEAT STORAGE UNIT MUST BE CLEAN AND CONTAIN LESS THAN 5% FINES. ROUND RIVER BED ROCK OF A GRANITE TYPE IS PREFERRED. HOWEVER, FRACTURED HARD ROCK MAY BE USED.

WASH ALL ROCK BEFORE IT IS INSTALLED IN THE HEAT STORAGE UNIT. WASHING MAY TAKE PLACE AT THE QUARRY OR AT THE JOB SITE. ROCK MAY BE POURED INTO PLACE WHILE IT IS DAMP BUT SHOULD NOT BE DRIPPING WATER. UNDER NO CIRCUMSTANCES SHOULD ROCK BE WASHED AFTER IT IS IN PLACE.

ROCK SIZING METHOD



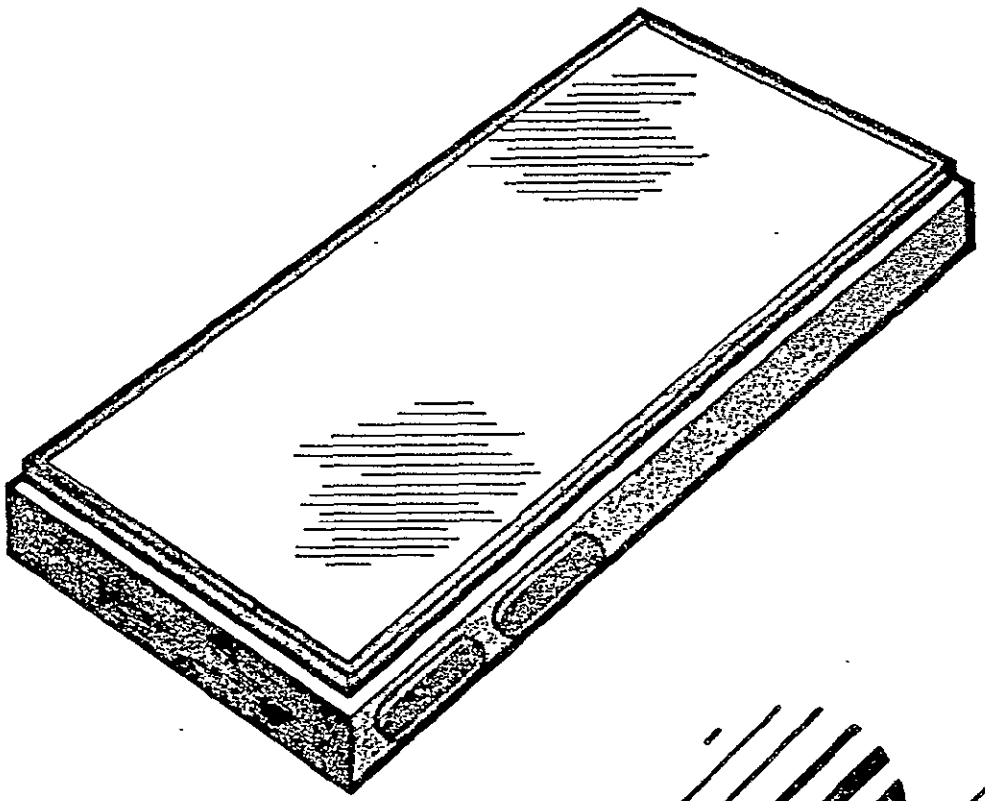
HEAT STORAGE UNIT

CONSTRUCTION CHECK LIST

		Refer to
☐	Calculate size of heat storage unit	p. 7
☐	Determine location of storage unit	p. 4
☐	Excavate (if required)	p. 4
☐	Prepare and install footings	p. 5
☐	Construct walls of storage unit	p. 9 - 15
☐	Install tie rod thru walls of storage unit	p. 9 - 15
☐	Seal interior of storage unit airtight	p. 5
☐	Install insulation in concrete box	p. 9 - 10
☐	Install bond beam block (if required, install transite duct support base and transite duct)	p. 5, 14, 18
☐	Install diamond mesh over bond beam block overlap 6" and turn up wall 12". Clamp mesh to transite duct, if used	p. 10, 12, 17, 18
☐	Obtain rock of proper size	p. 5, 19
☐	Clean rock	p. 5, 19
☐	Fill rock carefully onto diamond mesh	p. 10 and 12
☐	Fill remainder of storage unit, leave supply opening clear and maintain 8" plenum space with smooth surface	p. 10 and 12
☐	Caulk and install lid to seal airtight	p. 5

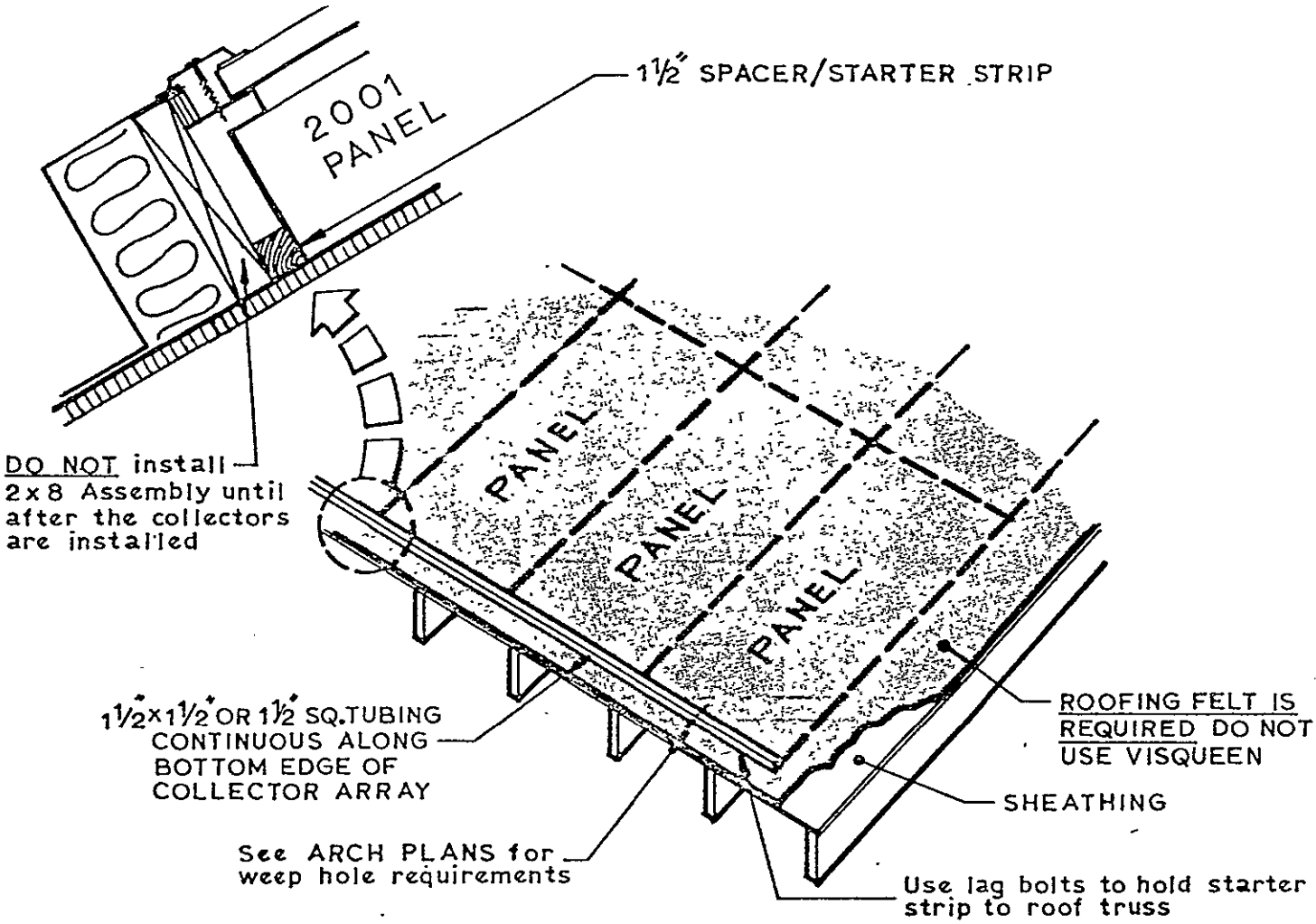
Installation, Operation, And Maintenance Manual

Series 2000 COLLECTOR PANELS



Collectors must be stored in dry area

SOLARON™
SOLAR ENERGY SYSTEMS
720 S COLORADO BLVD
DENVER COLORADO 80222
303/759-0101



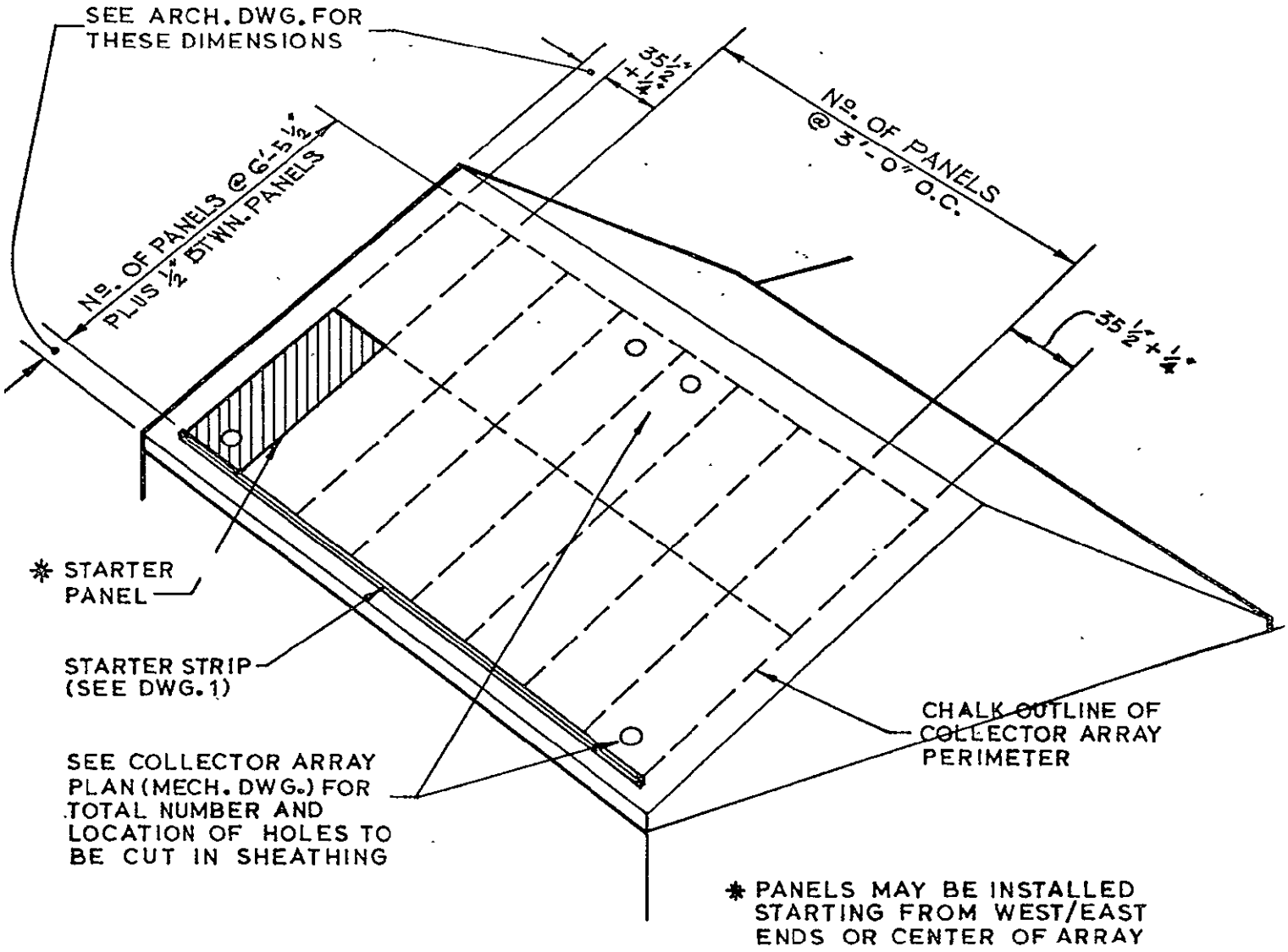
DWG. 1 STARTING PANELS SUPPORT STRIP

STEP #1

The builder and/or framer must install the roofing felt and the 1-1/2" x 1-1/2" starter strip at the bottom edge of the collector array as shown above, BEFORE any collector panel installation is started. This strip serves as support for bottom row of collectors until hold downs are installed and also is used to ensure proper alignment of the entire collector array. The collector array must be laid out so that it will fit on the roof with 6" clear on all sides for cap strip support and perimeter insulation. (see Drawing #2). Do not install 1-1/2" x 7-1/8" perimeter frame prior to collector mounting.

RECOMMENDED TOOL LIST

1/4" or 3/8" reversible, variable speed electril drill, sabre saw, reciprocating saw or skill saw, medium slot-type screw driver, 50 ft. or longer tape measure, 10 ft. to 16 ft. tape, chalk line, square (18"x24"), 2-7/16" hex sockets for 1/4" driver, two 1/4" X 6" extensions (to be mounted in drill chuck), utility knife, pliers (standard), Solaron pull-up tool (limited application), come-along with 30' min. cable length, sunglasses (polarizing), work gloves, safety helmets, safety ropes & accessories (if needed), ladders (appropriate for height of array being worked on), roof jacks (if required), machine for lifting collector onto roof (crane, front loader, etc.), matches or cigarette lighter, caulk gun, left & right snips, scratch awl, 5/16" dia. drill bit 10" long, Scribe.



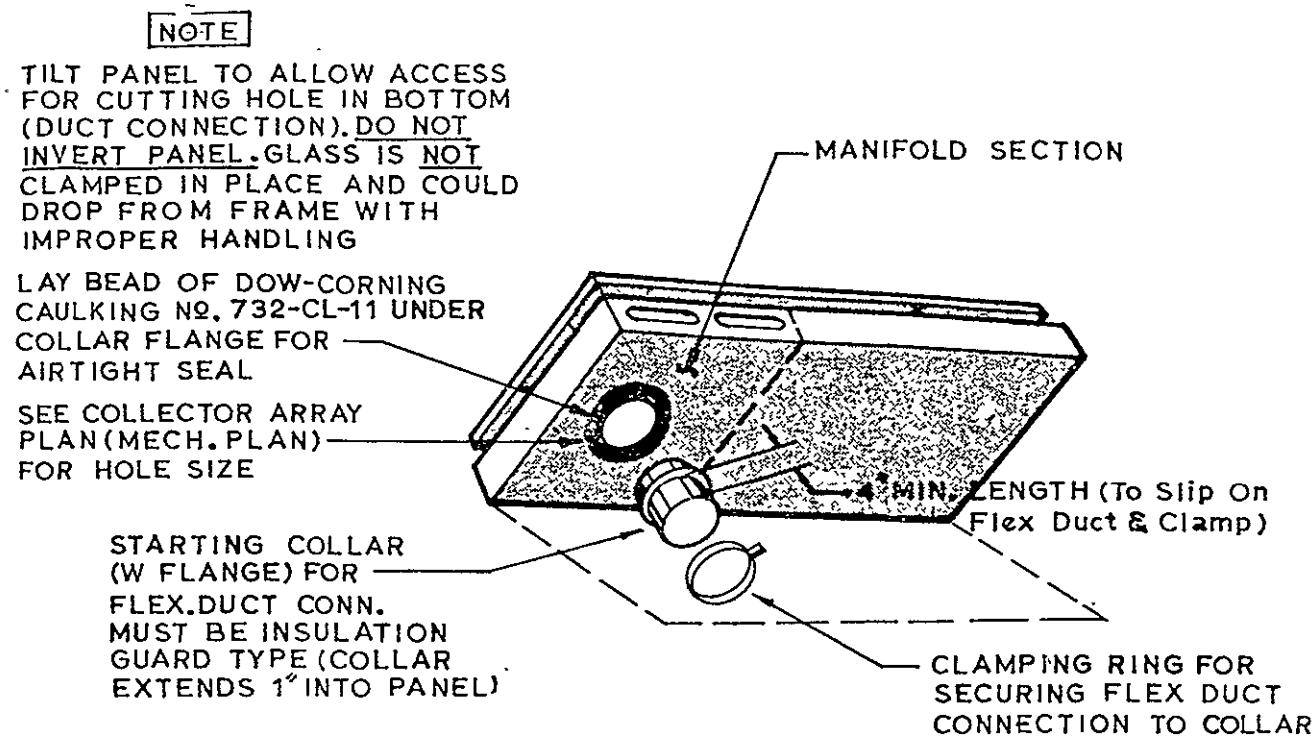
DWG. 2 ARRAY LAYOUT ON ROOF

STEP #2

Chalk outline of actual perimeter of the collector array onto the roofing felt, as shown above, making certain that your lines are square and plumb.

STEP #3

From plan of collector array (mech. drawing) determine location of holes to be cut in sheathing. These holes permit access for starting collar connection between panel and duct work (see drawing #3 & #5). The holes in the collector panels can only be cut in the manifold section as shown in drawings 3 and 5. This must be coordinated with roof sheathing holes. Cut roof sheathing holes 2" in diameter larger than collar (i.e. plans show an 8" collar, cut a 10" hole. Hole may be either round or square.



DWG. 3 CUTTING OF COLLAR HOLE (method 4a)

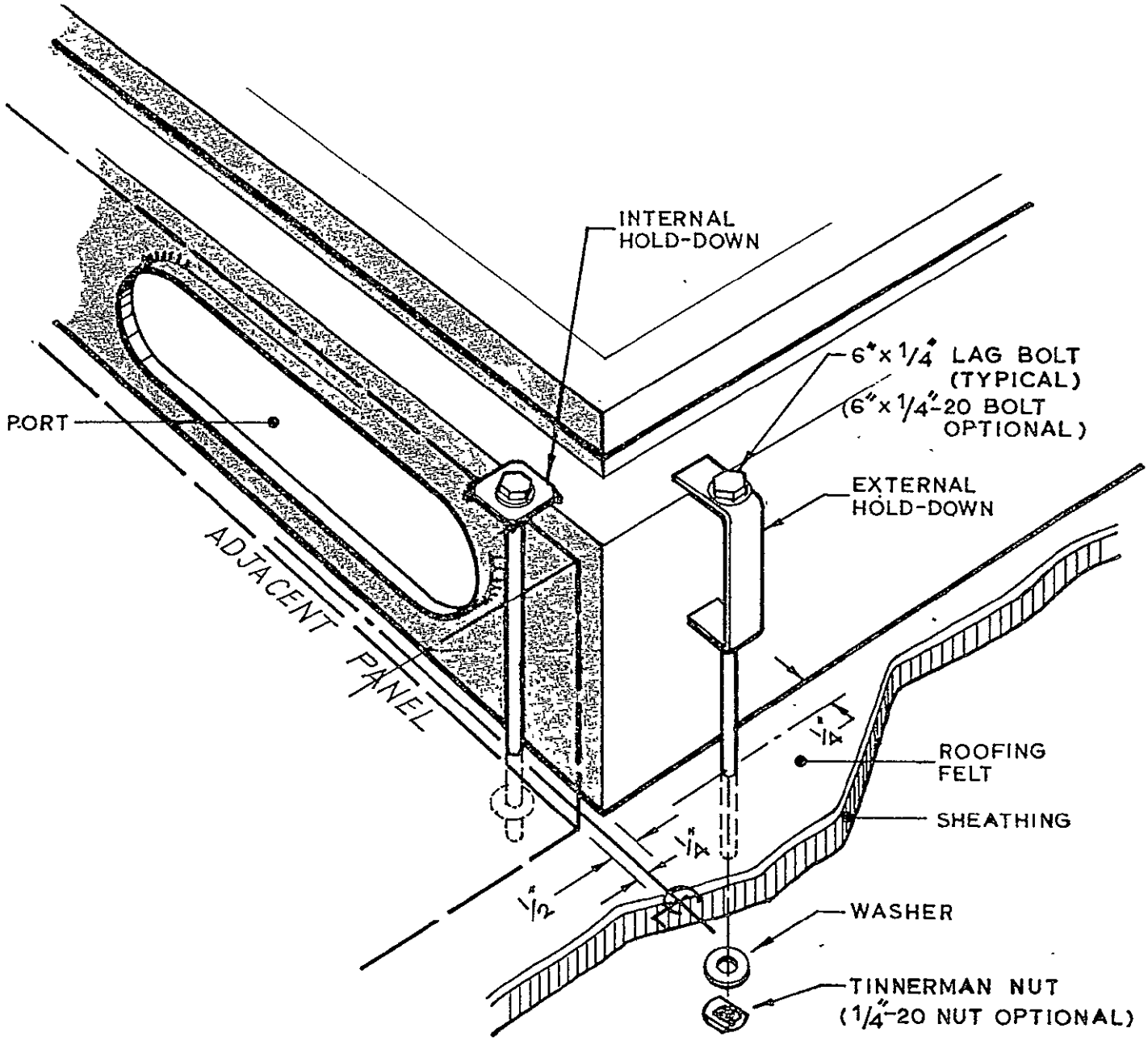
STEP #4

Collar holes to be cut in the collector panels by one of two methods as follows:

(a) Should the location of the mounted panel prevent easy access for hole cutting use method shown above for cutting hole before the collector panel is mounted to the roof sheathing. Make sure the hole you cut in the bottom of the panel and through insulation lines up with hole already cut in the roof sheathing.

(b) After collectors are installed securely on the roof (as per Step #5) cut the required holes in the bottom of each predetermined collector panel (confirm the size & location of each hole with the mechanical plans).

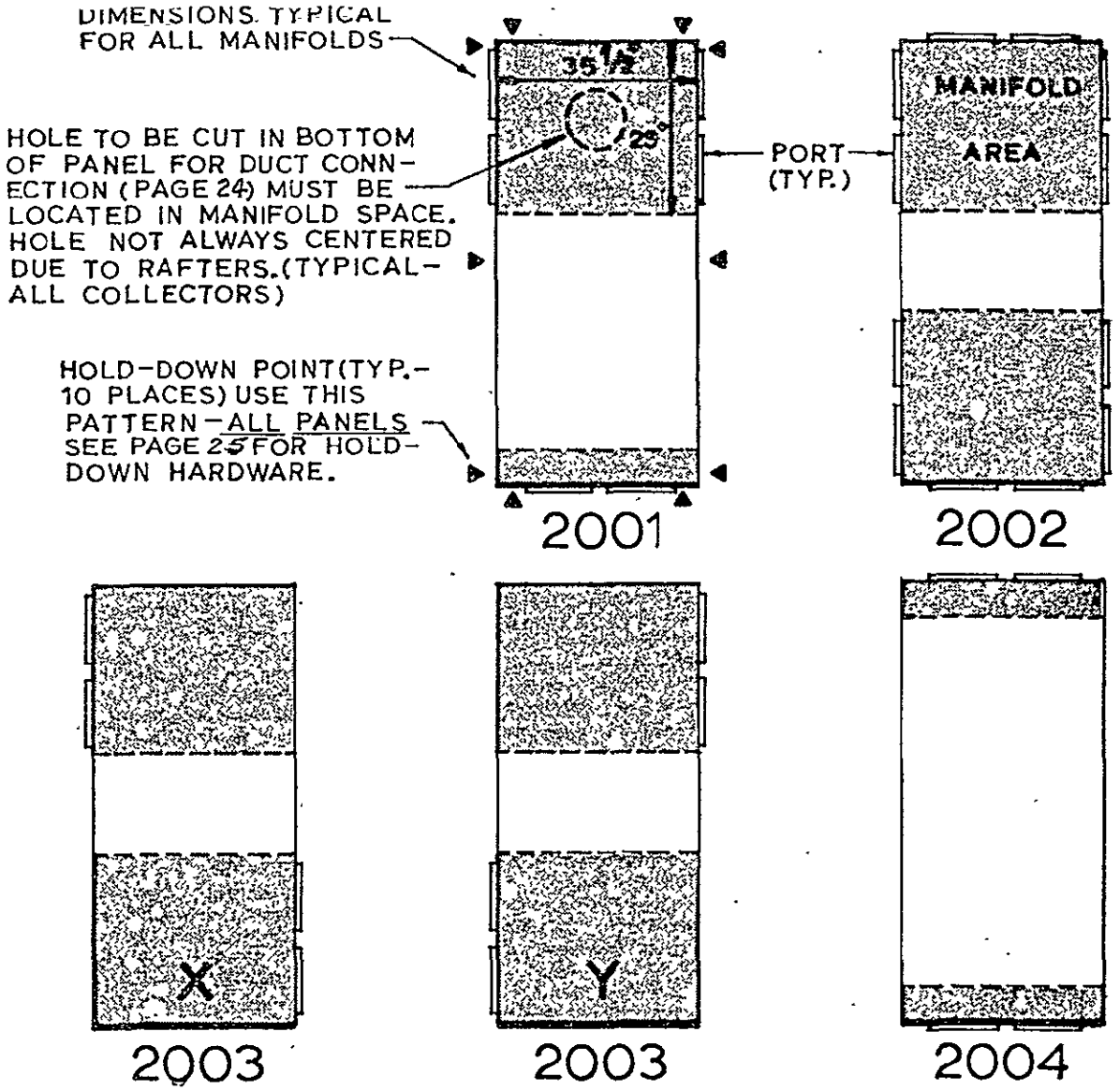
Any method of collar mounting requires caulking with Dow-Corning #732-CL-11 to form air-tight joint between collar flange and the collector.



DWG. 4 HOLD-DOWN HARDWARE INSTALLATION

STEP #5

Referring to drawings 4 and 5, drill 5/16" holes in roof sheathing for collector hold downs in designated places, as shown in drawing 5. Secure exterior hold downs after collector is in place. When two panels are mated, drill 5/16" holes for the interior hold downs after the adjoining collector is pulled tightly against the port gasket. The gasket must be kept clean and applied to a clean surface.



DWG. 5 HOLD-DOWN HARDWARE ATTACHMENT POINTS

STEP #5 (Cont.)

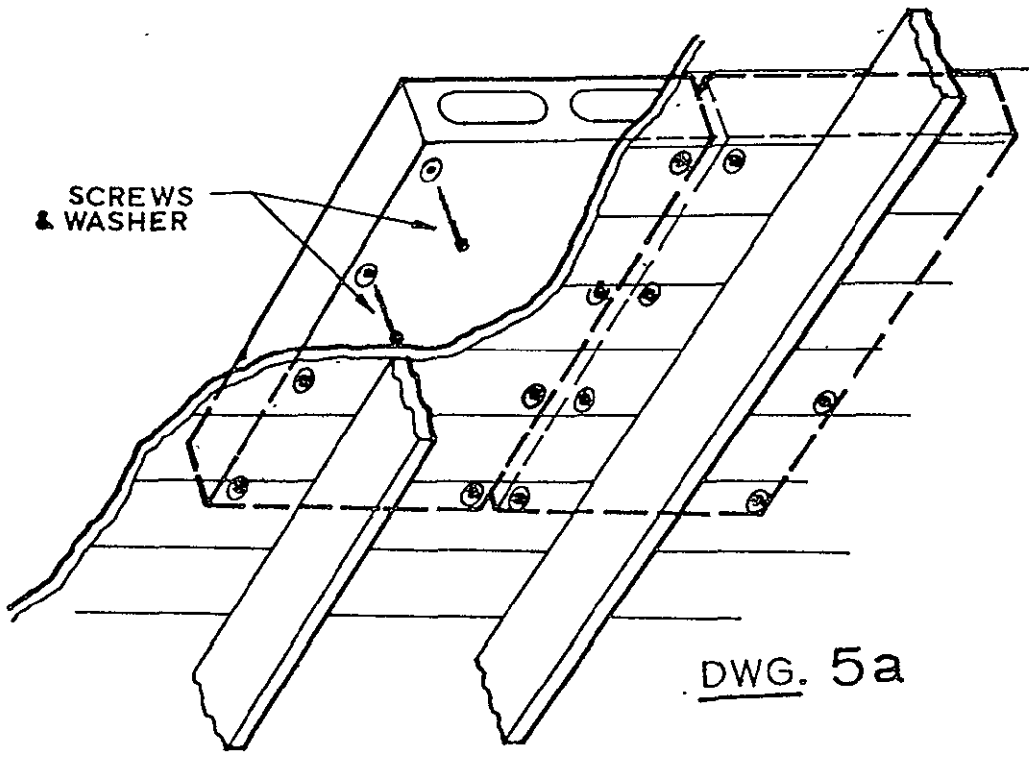
Place each bolt with clamp into its proper hole (external hardware around the perimeter and internal hardware between collector panels - see drawing 4). One person must put a washer and a lock nut onto the same bolt from the attic side of the roof and tighten. A 7/16" socket & 7/16" open end wrench or adjustable wrench is recommended for tightening hold down bolts. Internal hold down should "dimple" collector metal. Exterior hold down should catch rivet. Should the location of the collector place the hold down bolt directly over a structural member you have two methods of mounting. 1) Discard the 6" x 1/4" bolt and use a 6" x 1/4" lag bolt. Tighten directly into the structural member. 2) Discard the 6" x 1/4" bolt and drill a 5/16" hole all of the way through the structural member. Use 1/4" all-thread to the required lenght and mount as described above. CAUTION - be sure the structural integrity of a member is not affected by this method of mounting BEFORE you start drilling.

Lag Hold-Downs

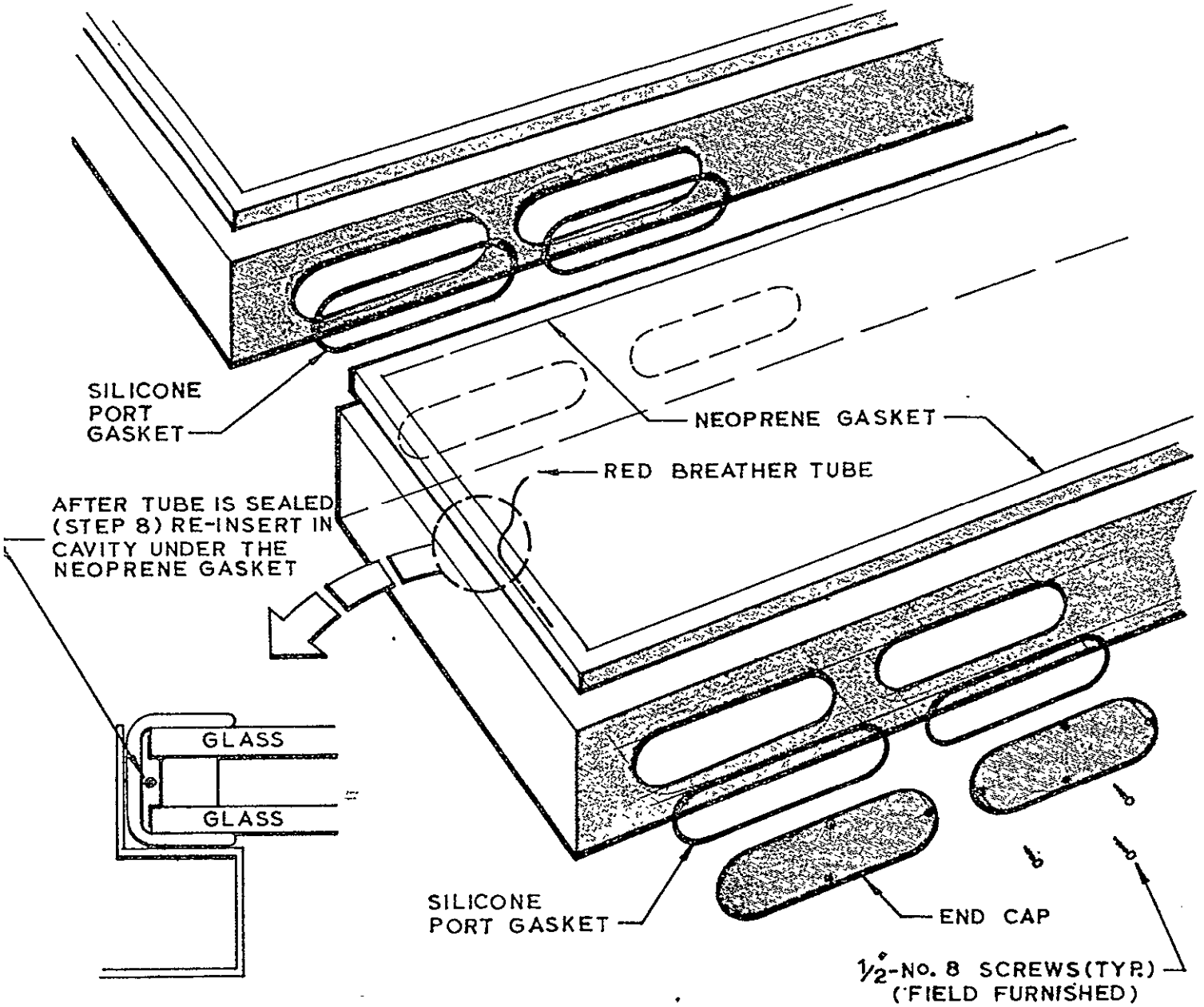
Place the hold down hardware (i.e. 6" X 1/4" lag bolt with the appropriate interior or exterior clamp) at the attachment points shown in drawing 5. Screw the lag bolt into the roof sheathing by using a 7/16" hex socket (on a 1/4" extension) and a 1/4" or 3/8" electric drill. Interior hold down clamps must dimple the collector metal to hold properly. Exterior clamps should catch one of the rivet heads on the collector. After lags have been drilled into place, a washer and tinnerman must be placed on the tip of lag from the underside of the roof.

Screw Hold-Downs

After placing collector in position, secure in place using 4 lag bolts or bolts. Using bugle-head drywall screws (2 3/8" #S12 or 6-20 X 1 5/16" flooring screws) drill into the backside of the collector and roof sheathing from the attic area. Eight (8) screws are required; four on each side near the edge of the collector. This procedure is recommended for very steep roof angles. DO NOT use sheetmetal screws for this application. Eight washers are also required and should be placed on the screw before drilling.



DWG. 5a

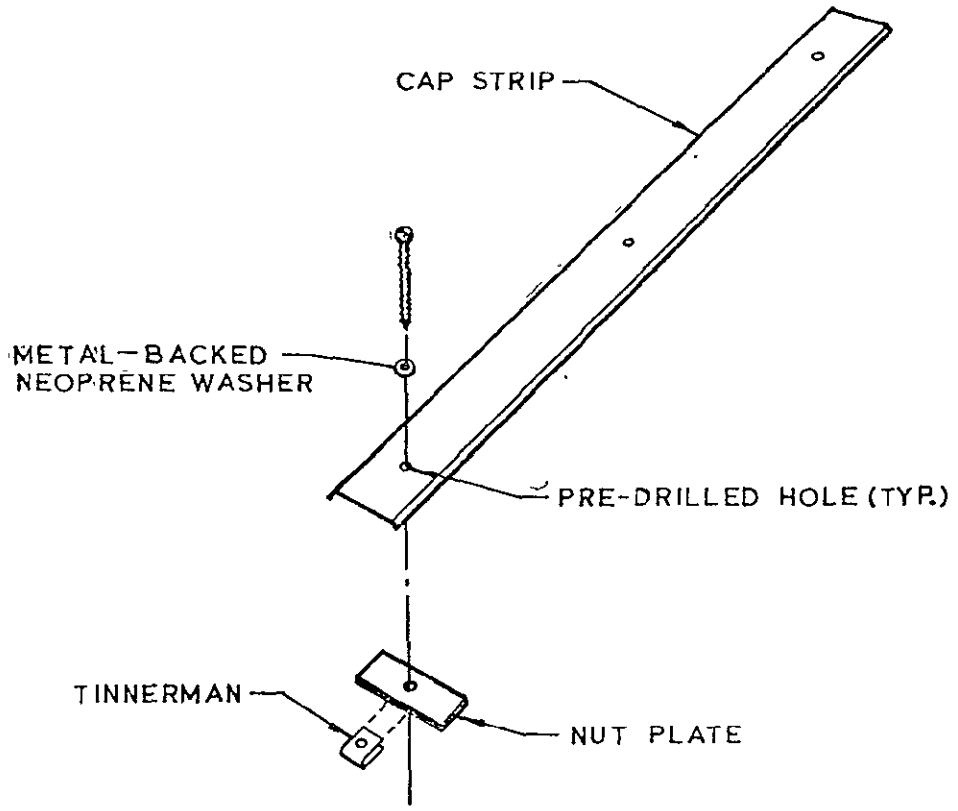


DWG. 6 PORT CONNECTIONS

STEP #6
Install the silicone gasket and attach end cap with screws to the collector panel, as shown above, making sure you obtain an airtight seal. As each panel is positioned in its location be sure that the gasket has been properly mounted around each port that will be immediately mated to an adjacent collector panel port. The gasket must seat evenly around the port to insure an airtight seal.

STEP #7
Lay a bead of Dow-Corning #732-CL-11 caulking compound around the opening in the bottom of the collector panel as shown in Drawing 3. This is to insure an airtight seal between the collector and the starting collar flange. Mount the starting collar in such a manner that will make a solid, airtight connection.

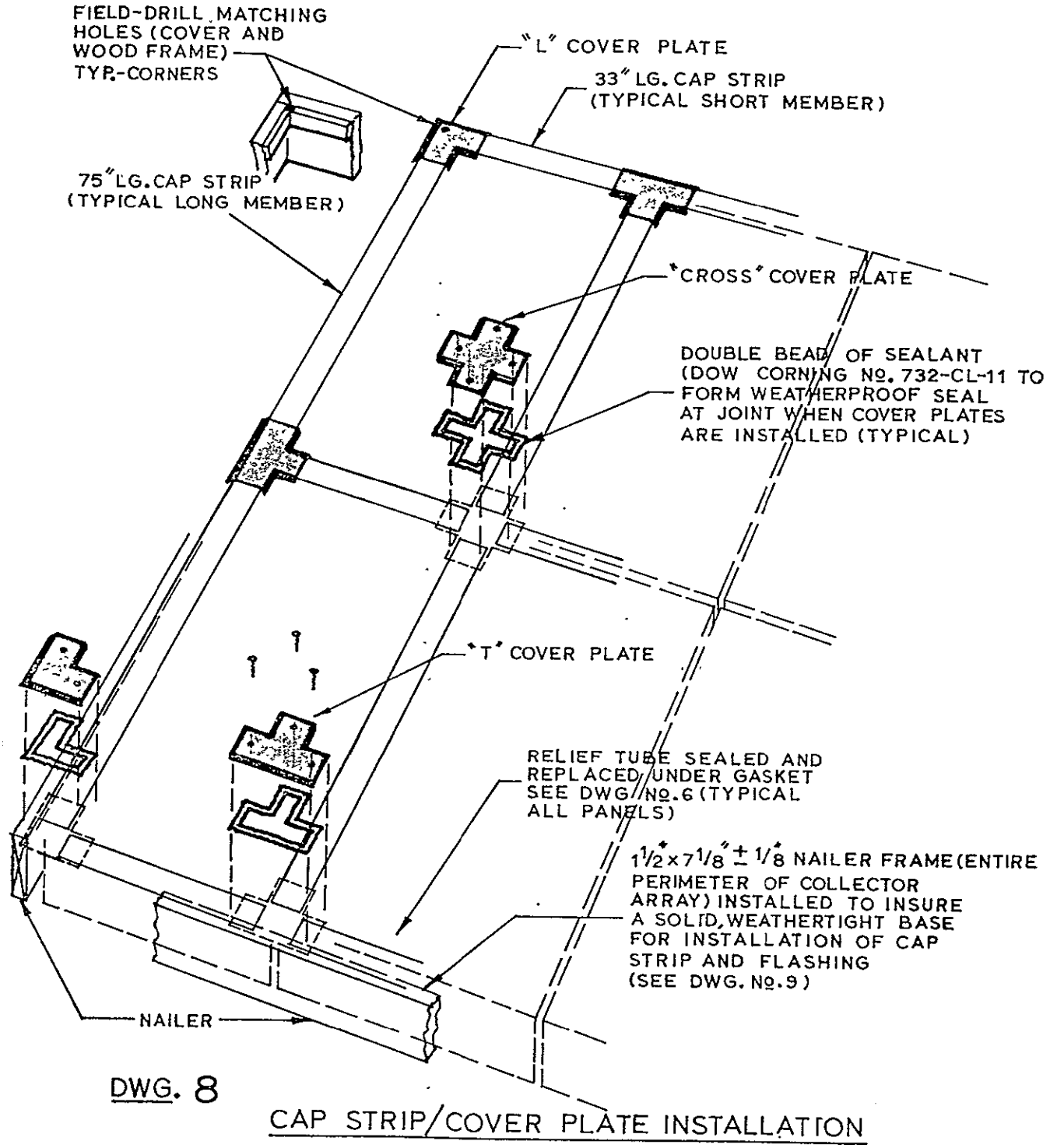
STEP #8 Relief Tube -
When collector is in place and secured, but before cap strip is installed, check red nylon pressure relief tube to make sure it is open so that pressure between panes of glass has had time to equalize to local atmospheric pressure. Next, seal tube by tying knot in tube and permanently sealing end by melting and squeezing the open end closed. Now place closed tube under neoprene gasket along the edge of the glass (see detail on dwg 6) & return gasket to normal position.



DWG. 7 CAP STRIP ASSEMBLY

STEP #9

After all the collectors are in place and secured, coordinate with builder to install 1-1/2" x 7-1/8" frame assembly around perimeter of array as per drawings 8 and 9 (mounting cap strip and flashing). Flashing must be installed before perimeter sealant and perimeter cap strip can be installed.

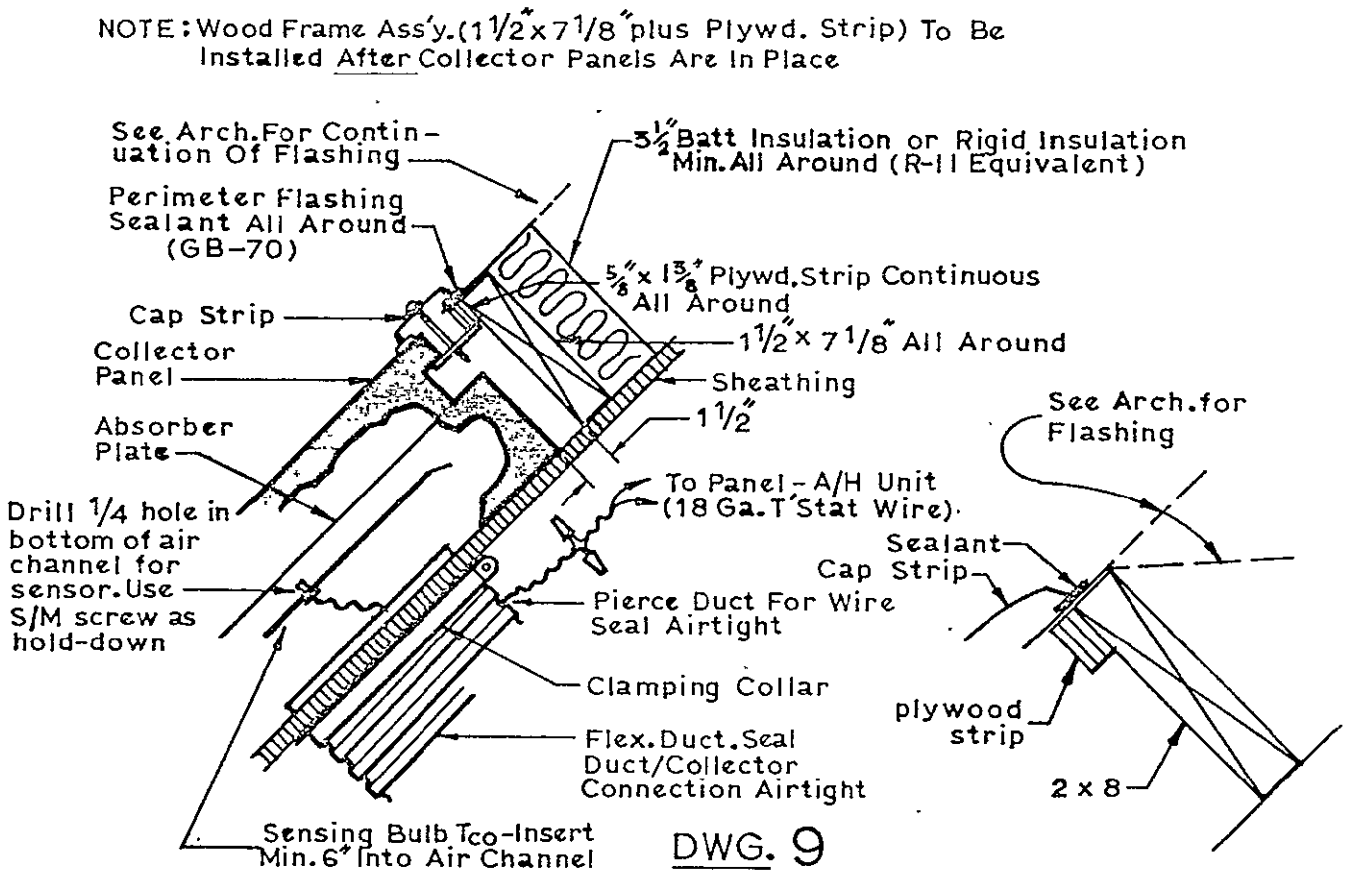


DWG. 8

CAP STRIP/COVER PLATE INSTALLATION

STEP #10

Referring to Drawings 7 & 8 start installation of cap strip. Cap strip is mounted with 2-1/2" screws and metal backed neoprene washer. Place screw with washer through pre-drilled holes in cap strip. See Drawing 7. Turn the screw into the tinnerman clip approximately 3 turns. Place cap strip so that each edge is lined up on collector glass gasket evenly with nut plates under glass enclosure lip. By pressing on the screw while turning to secure nut plate, you will keep nut plate straight so that it will secure itself under adjacent glass enclosure shelves. Cap strips between collectors should be mounted during collector installation to hold glass in place.



COLLECTOR FLASHING/SENSOR PLACEMENT

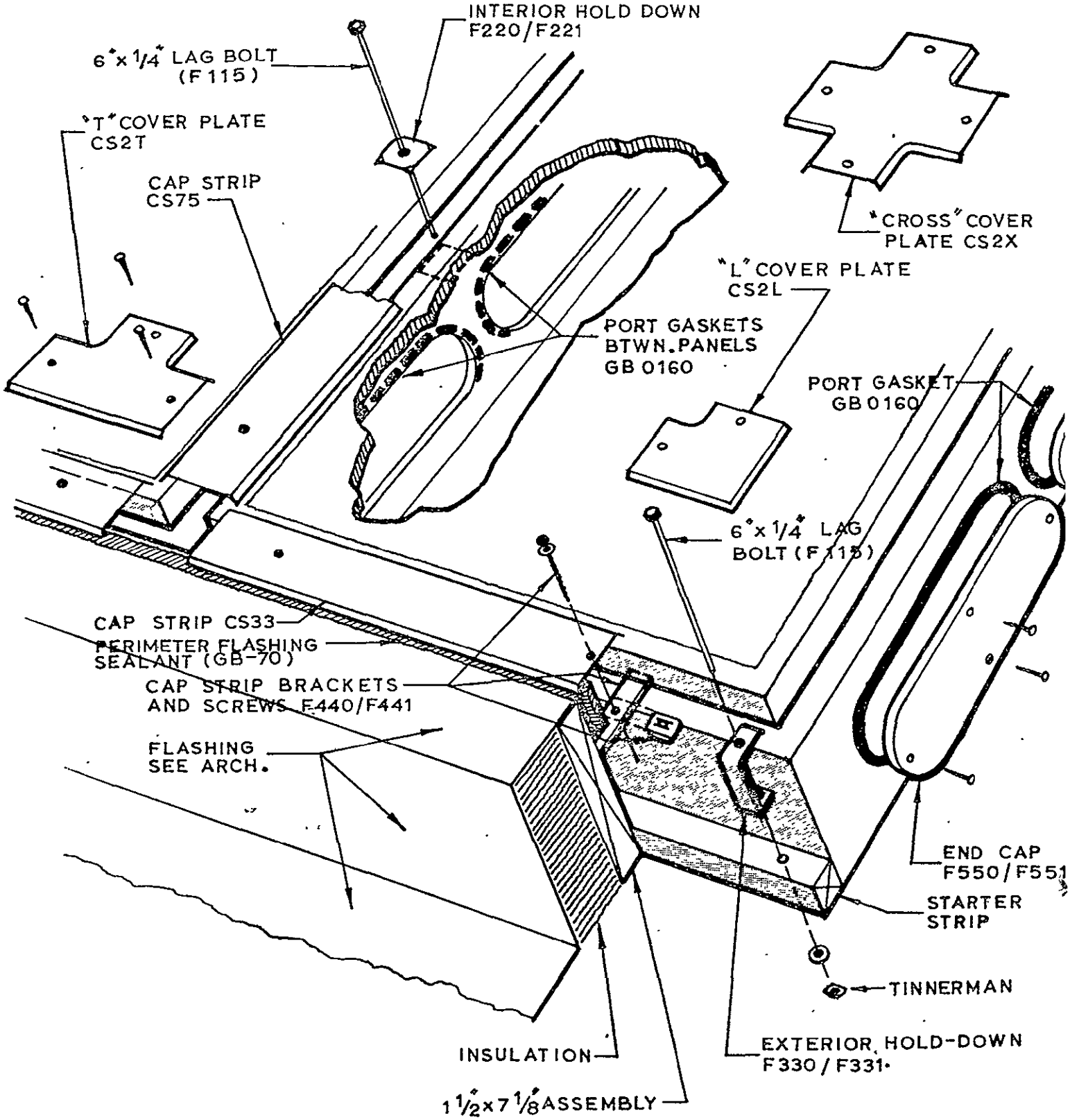
STEP #11

When you install the perimeter cap strip, the same procedure is followed, except that you will be placing one edge of cap strip on glass gasket and the other edge into the perimeter flashing sealant (See drawing 9). Flashing sealant is placed on flashing prior to cap strip mounting.

STEP #12

When installing the "Cross, El or Tee" cover plates, run a double bead of Dow-Corning 732-CL-11 silicone caulk on the cap strip as shown in Drawing 8. Install 5/8" Tec self-drilling screws in pre-drilled holes and tap into cap strip. A third hole must be drilled into the 90 degree L in accordance with the wood backing to obtain a tight seal in the corners (see Drawing 8).

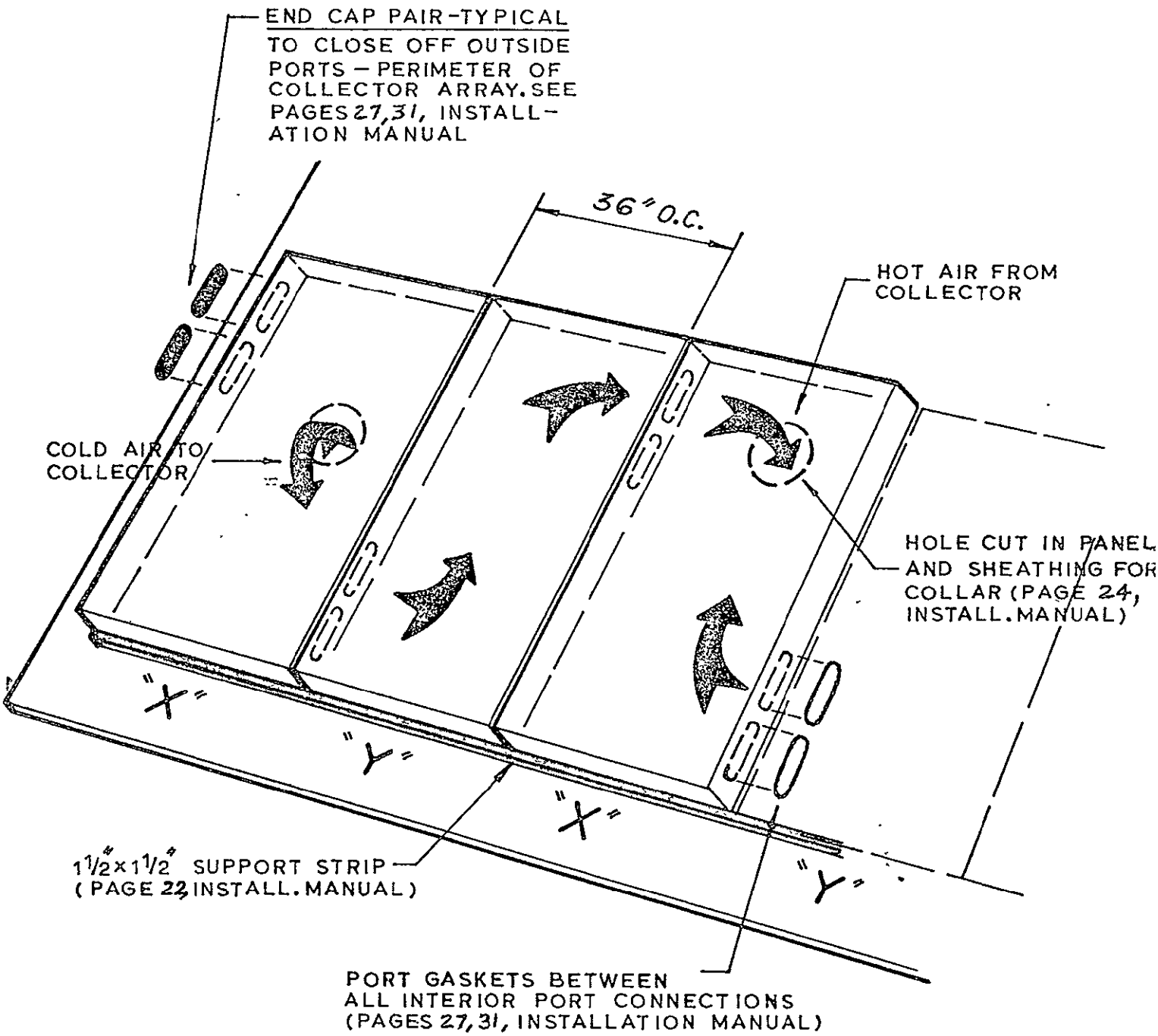
NOTE: 2-1/2" screws, metal backed neoprene washers, nut-plate and tinnermans & 5/8" self-tapping screws furnished by Solaron.



DWG. 10 ASSEMBLY DETAILS

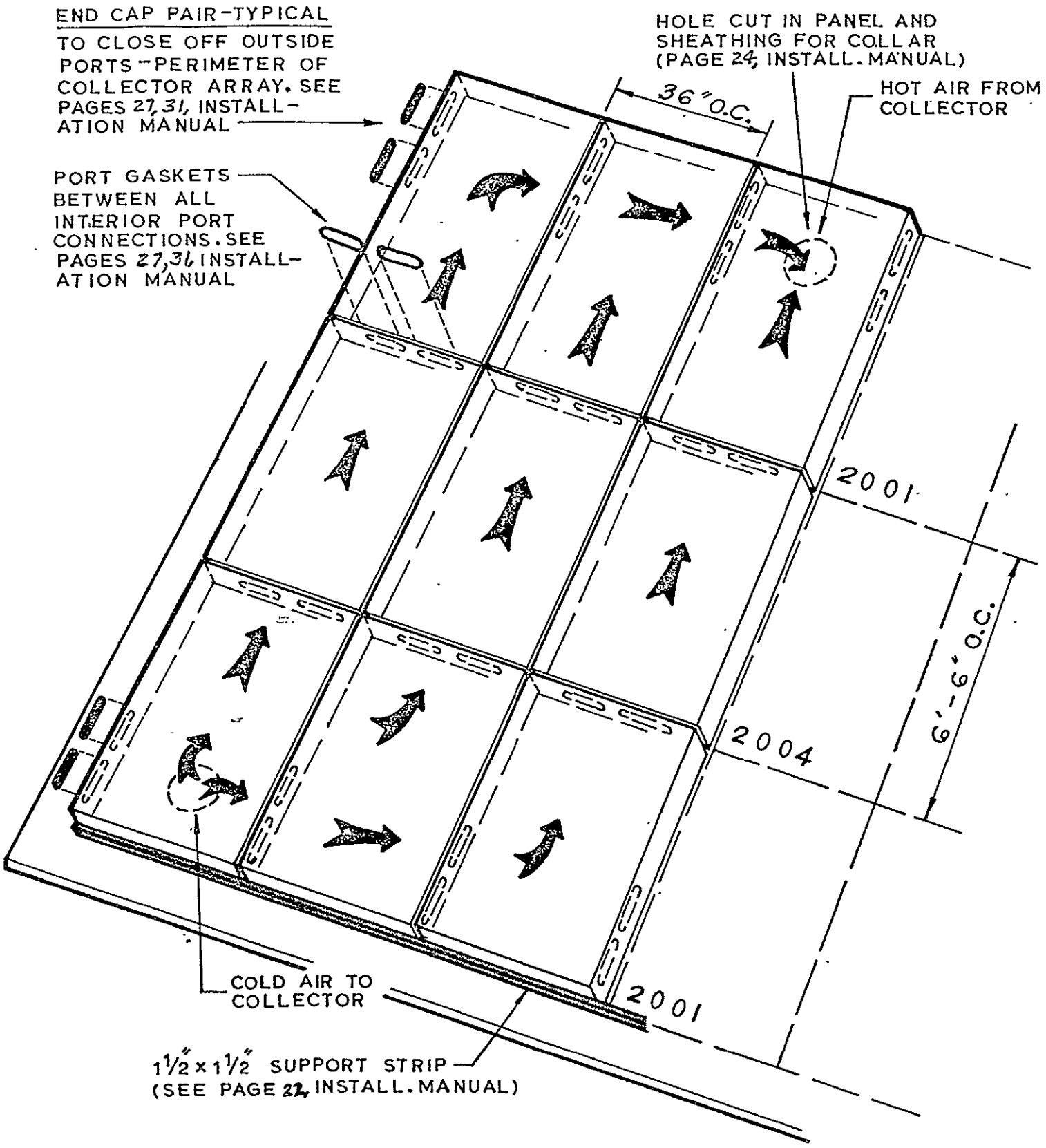
1 HIGH VERTICAL ARRAY

(2003 "X" and "Y" PANELS)



SEE INSTALLATION MANUAL FOR ADDITIONAL INSTRUCTIONS

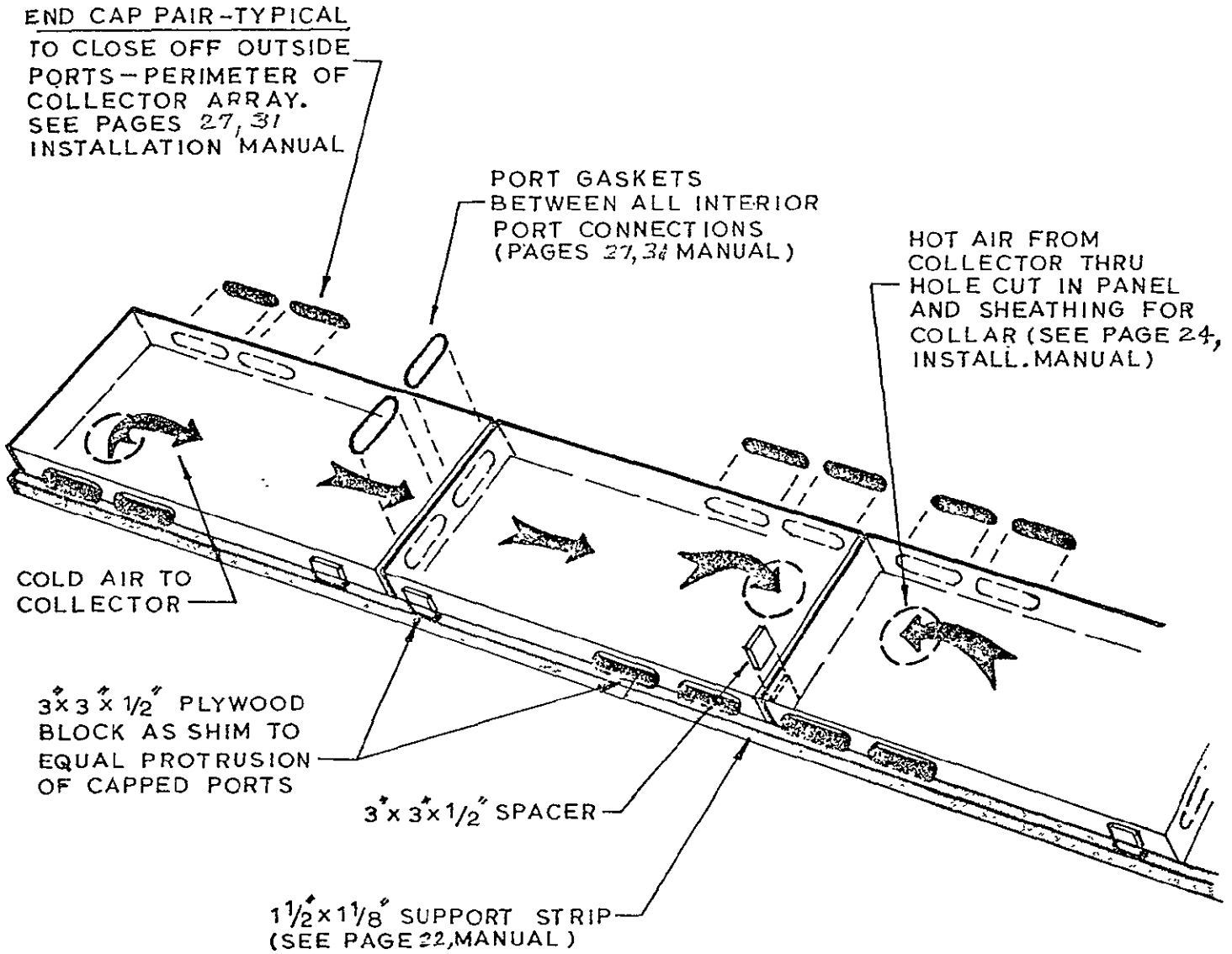
3 HIGH VERTICAL ARRAY



SEE INSTALLATION MANUAL FOR ADDITIONAL INSTRUCTIONS

1 HIGH HORIZONTAL ARRAY

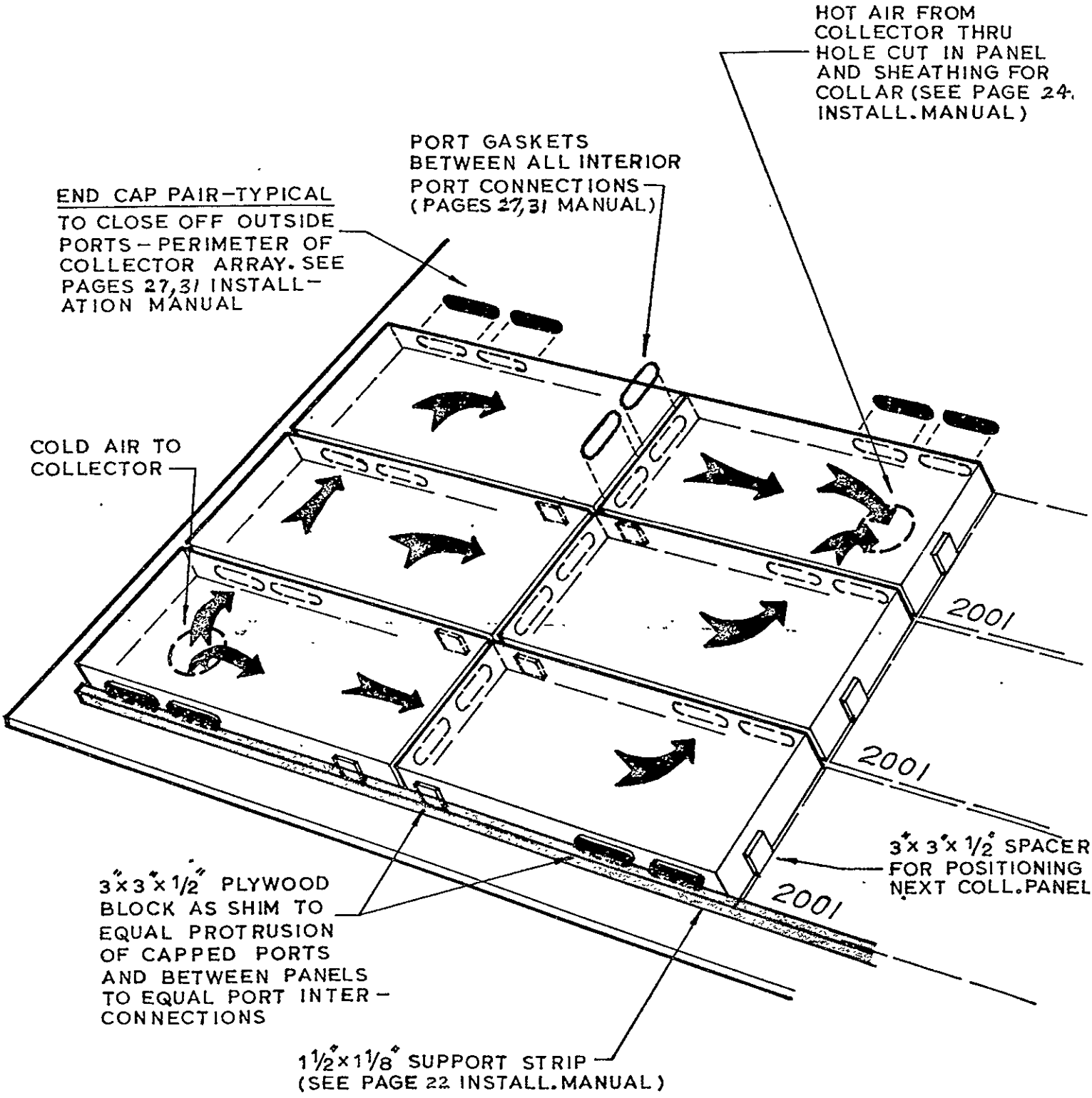
(2001 PANEL)



SEE INSTALLATION MANUAL FOR ADDITIONAL INSTRUCTIONS

3 HIGH HORIZONTAL ARRAY

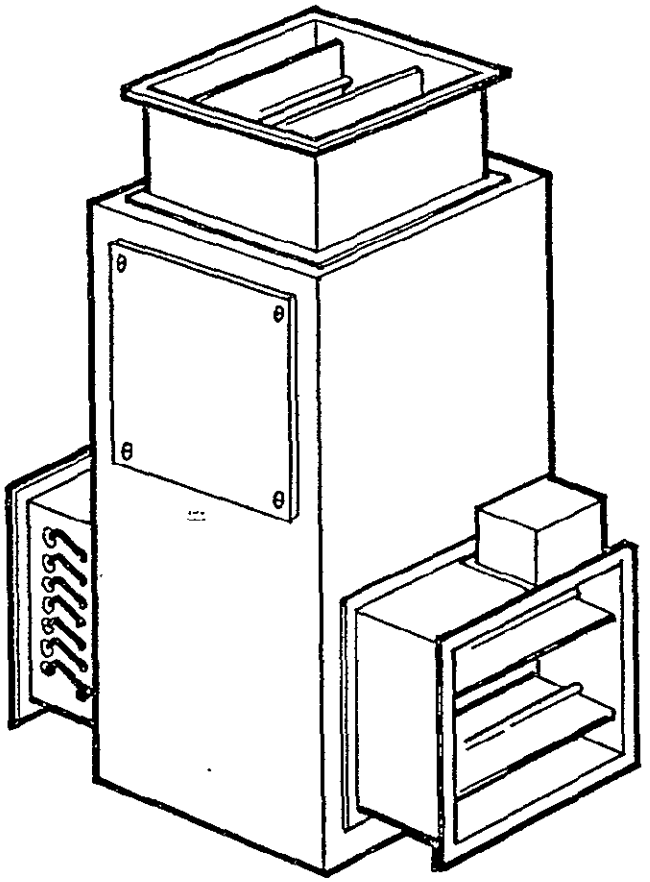
(2001 PANEL)



SEE INSTALLATION MANUAL FOR ADDITIONAL INSTRUCTIONS

Installation, Operation, And Maintenance Manual

INLET



SERIES
AU0400
&
AU0500
AIR
HANDLER

Solaron™ Corporation reserves the right to make changes at any time, without notice, in materials, equipment, specifications, prices, models and design criteria, and to discontinue models.

SOLARON
SOLAR ENERGY SYSTEMS
TM

SOLARON CORPORATION™
300 GALLERIA TOWER
720 SO. COLORADO BLVD.
DENVER, CO. 80222 (303) 759-0101

SOLARON AU0400 AIR HANDLING UNIT

Solaron's model AU0400 series air handler units are shipped less motor and internal wiring to facilitate installation in a wide variety of applications. All AU0400 series units are manufactured with highly reliable belt drive type blowers. Motors are to be field installed to match each installations air delivery requirements. Compatible motors are 1/3, 1/2 & 3/4 H.P. of 115 or 230 volt power input. Class "B" insulation types of motors are required for use in the AU0400 units due to the higher operating temperatures typical of an air-type solar heating system. All units have a factory mounted "J" box for convenient line voltage field wiring.

WARNING: Do not install the AU0400 unit in a corrosive, explosive or contaminated atmosphere for any reason. Installation of this unit is subject to all applicable local and national building codes and ordinances.

The Solaron AU0400 may be mounted in several positions. Any mounting position must result in the blower shaft being in a horizontal position (i.e. parallel to the floor). DO NOT MOUNT in a position that places the blower shaft in a vertical orientation.

The AU0400 may be suspended from ceiling joists, wall-mounted or floor mounted. Provide adequate vibrations isolators to insure quiet operation.

NOTE: The AU0400 contains no electric heating coils or gas-fired exchangers that produce inherently high temperatures.

REQUIRED DAMPER MOUNTING

Mounting the Solaron dampers on the inlet and outlet of the AU0400 air handler is easily accomplished if the steps listed below are followed:

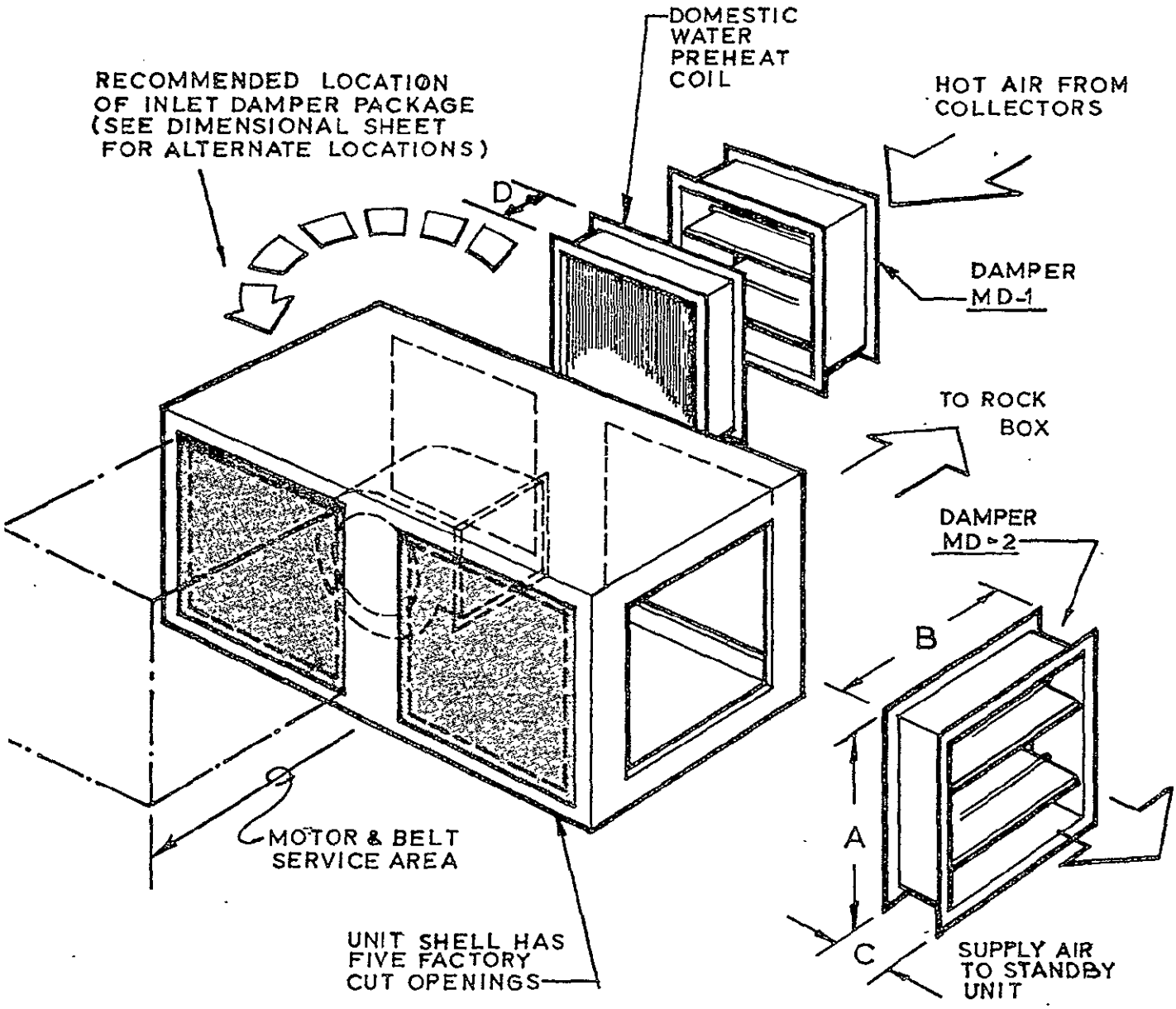
1. If the system incorporates the optional domestic water preheating, mount the water coil assembly to the inlet of the AU0400 unit using sheet metal screws. (If the inlet is to be on the end of the AHU, an opening must be field cut). Next, mount damper MD1 onto the mounting flange of the water coil assembly.

2. Position and mount with sheetmetal screws damper MD1 (inlet from collector "normally closed") over the opening on the inlet of the air handler, or water coil if used. Dampers are labeled to indicate direction of air flow and must be installed accordingly.

3. Position and mount with sheetmetal screws damper MD2 (outlet to auxiliary heating unit "normally open") over one of the openings on the outlet of the air handler. Field cutting may be required.

4. Position and mount the field supplied duct over one of the other openings on the outlet of the air handler going to the top of the heat storage bin.

NOTE: The damper motor must be mounted in a position that results in the output shaft of the damper motor being in a horizontal position (i.e., damper blades must be parallel to the floor). All joints must be sealed air-tight with silicone caulking.



Model No.	DAMPERS DOM. WATER COIL			
	A	B	C	D
AU-0400	16"	16"	8"	6"
AU-0500	20"	20"	10"	6"

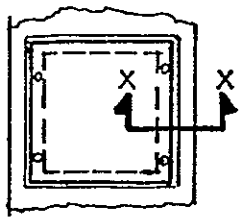
TWO COVER PANELS ARE WITH UNIT. ADDITIONAL PANELS MUST BE FIELD FABRICATED.

Domestic hot water coil should be located on the outlet of the air handler (to rock box) as shown on the front cover

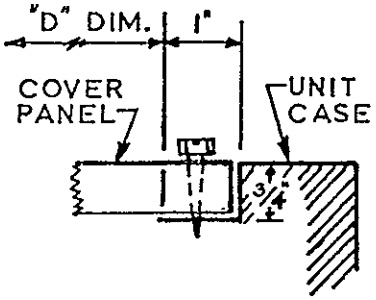
AU-0400 AND AU-0500 AIR HANDLING UNITS

DIMENSIONAL INFORMATION

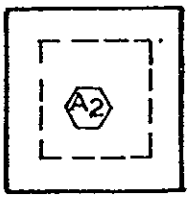
The above drawing will furnish orientation information as well as essential dimensional data.



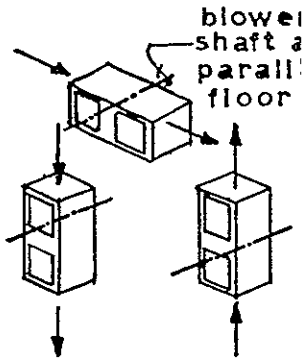
COVER PANEL
(2) SUPPIED



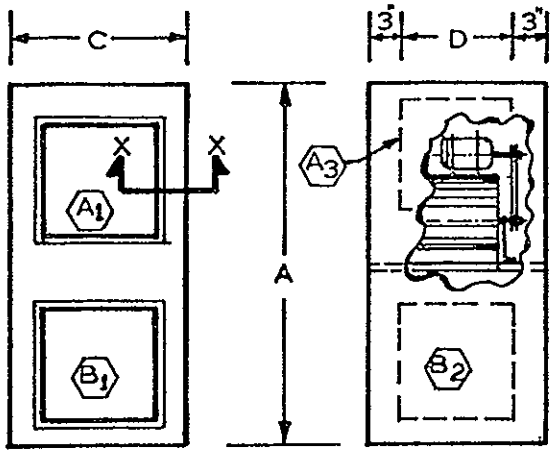
SECTION X-X



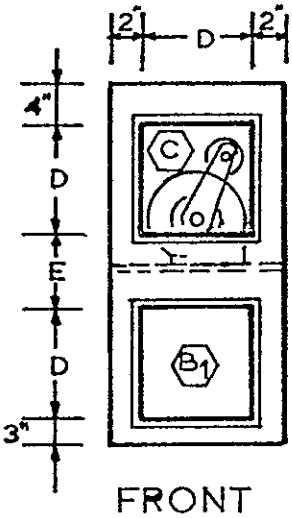
TOP



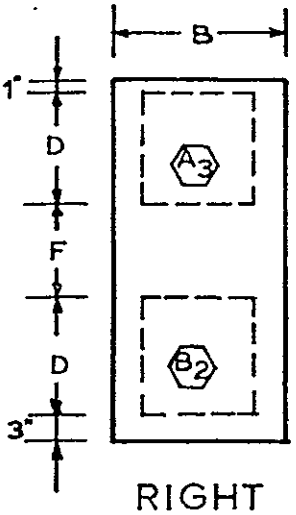
MOUNTING POSITIONS



BACK = LEFT



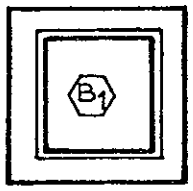
FRONT



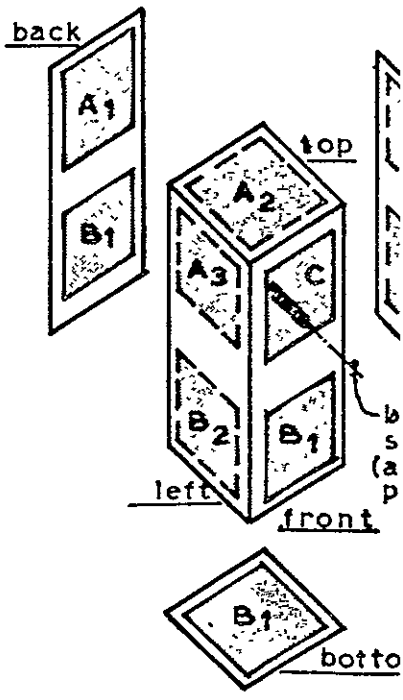
RIGHT

DIMENSIONS

UNIT	A	B	C	D	E	F
AU-0400	42	20	18	14	7	10
AU-0500	51	24	22	18	8	11



BOTTOM



NOTES

INLETS

- A1 FACTORY CUT (DO NOT USE)
- A2 FIELD CUT (RECOMMENDED)
- A3 FIELD CUT (8% FAN CAPACITY REDUCTION)

OUTLETS

- B1 FACTORY CUT (STANDARD)
- B2 FIELD CUT (OPTION)
- C SERVICE ACCESS FOR MOTOR AND DRIVE REMOVAL

AU0400 & AU0500 AIR HANDLING UNIT

Locate the filter "upstream" of backdraft damper BD-1 (and "by-pass" duct when used).

FILTERS

The Solaron air system requires a filter in the return air duct supplying air to the inlet side of the collector and the heat storage bin. A filter is not needed in the AU0400/AU0500 unit.

Should an electronic air cleaner be desired, install it in the return air duct mentioned above. DO NOT install on the inlet of the auxiliary furnace as the air temperatures at this location may exceed the electronic air cleaner's maximum operating temperature (usuall 125°F).

HUMIDIFIERS

Horizontally mounted type humidifiers are recommended. Locating the humidifier in a horizontal supply duct coming off of the auxiliary heating unit is ideal. Utilizing a sail-switch activated duct humidistat (similar to a Honeywell H49B) will simplify the wiring requirements of most installations.

DO NOT wire low voltage humidifiers or air cleaner relays in series with the thermostat wires (W_1 or W_2) as this can damage the Solaron controller. Sail or air pressure switches are recommended.

LOCATING THE THERMOSTAT

The Solaron multi-element thermostat should be located on an interior wall free from cold and warm drafts. Be sure adequate room air movement is present so the thermostat will provide a comfortable building temperature.

Do not locate the thermostat near lamps, heat outlets, stoves, refrigerators, television sets, etc. The heat given off by these appliances will not allow the thermostat to properly control the building temperature.

The thermostat heat anticipators should be set as follows: W_1 @ .10 amp, W_2 @ .10 amp.

SOLARON CONTROLLER & THERMOSTAT LIST

AU0400 and AU0500 air handler can be used in various applications.

Application	Solaron Controller	Thermostat & Sub-base	Additional Relays Needed
Heating Only	HC0115	HC0020 HC0040	(3)#SR0225 Relays 1-AU0400 Blower 1-Dom. Water Pump 1-Aux. Blower
Heating Only with continuous fan option	HC0115	HC0020 HC0041	(3)#SR0225 Relays Same as Above *(1)#SR0157 Relay
Heating/cooling with continuous fan option	HC0115	HC0022 HC0041	(3)#SR0225 Relays Same as Above *(1)#SR0157 Relay
Heat pump-reversing valve energized for heating	HC0116	HC0022 HC0042	(2)#SR0225 Relays 1-AU0400 Blower 1-Dom Water Pump
Heat Pump-reversing valve energized for cooling	HC0116	HC0023 HC0042	(2)#SR0225 Relays Same as Above

*Insert SR0157 relay into fourth base of HC0115

LOCATING THE SOLARON CONTROL PANEL

Mount the control panel in a convenient location that allows easy access for electrical wiring and "summer/winter" switch operation. Generally the mechanical room is the best location. Electrical service consisting of one 115 vac circuit is ample to power the 100 VA, 120 VAC/24 VAC transformer accompanying the control panel. Separate power circuits may be needed for the AU0400/AU0500 unit and the auxiliary heating unit (refer to local and national building codes).

Low voltage wiring is needed to connect the Solaron space thermostat to the Solaron control panel as well as between the auxiliary heating unit, damper motors and the control panel. Damper motors are low voltage.

The thermostat MUST be wired through the Solaron control panel, it CANNOT be wired direct to the auxiliary heating unit and Solaron air handling unit.

See instructions with each controller for specific directions and information on wiring schematics.

SOLAR SYSTEMS SENSORS

Sensors must be properly placed in the following locations before system start-up can be accomplished:

1. Tco - Sensor must be in absorber plate air channel (not in duct connection or manifold plenum).
2. Tci - Locate at junction of house return air duct and duct connecting to bottom of heat storage (for systems with by-pass of heat storage for summer water pre-heating, locate in duct to collector where by-pass tees in).
3. Ts - Top of rock in heat bin.
4. Tw - Locate in bottom of water storage tank (not the auxiliary water heater) near inlet of heat exchanger coil. (If using an unwired electric water heater for a storage tank, the thermostat in the tank can be used as Tw. Disconnect power leads from thermostat and power element and wire through terminals that "open" on temperature rise).

SYSTEM START-UP

Please review all steps before proceeding with the system start up of the Solaron Air Handler AU0400/AU0500.

1. Check for proper mounting of belt-drive motor (field installed).
2. Check belt tension.
3. Check pulleys for tightness on shafts.
4. Remove all tools, materials, etc. from inside unit.
5. Check auxiliary heating unit as per manufacturers recommendations.
6. Turn on power to solar air handling unit and controller.
7. Check rotation of solar air handler blower.
8. Turn on power to auxiliary heating unit.
9. Secure all access doors.
10. Check operation of all components and systems as per Solaron control instructions.
11. Give the system owner instructions on how to operate their new Solaron solar system.

BLOWER MOTOR AND DRIVE ASSEMBLY SELECTION PROCEDURE

1. Refer to building plans for air flow and static pressure requirements. Include pressure drop of all dampers and coils in system. (See Selection Example this Manual Pg. 10.)
2. Refer to the Air Delivery Table for each respective air handler:
   a. select the row which indicates that static pressure required, and
   b. select the column which shows the CFM required.
   The point where the row and column intersect will indicate what blower RPM and H.P. motor are needed to deliver the required air flow.

AU0400 AIR DELIVERY TABLE

"W.C." Ext. Static Pressure	CFM												
	1/4 H.P.					1/3 H.P.				1/2 H.P.		3/4 HP	
	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	
.6	-	-	-	-	-	-	-	-	-	1055	1120	1150	
.8	1038	1041	1045	1045	1048	1058	1060	1092	1120	1156	1187	1235	
1.0	1185	1190	1157	1158	1158	1159	1160	1190	1220	1245	1280	1310	RPM
1.2	1300	1300	1295	1279	1265	1260	1270	1290	1310	1335	1360	1389	
1.4	-	1422	1405	1385	1375	1370	1370	1375	1400	1420	1455	-	

AU0500 AIR DELIVERY TABLE

"W.C" Ext. Static Pressure	CFM															
	3/4 H.P.							1 H.P.				1-1/2 H.P.				
	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	2500	2600	
.8	-	-	-	-	-	-	1000	1021	1040	1064	1088	1116	1143	1171	1200	
1.0	1028	1032	1041	1043	1053	1064	1078	1093	1111	1132	1155	1181	1205	1234	1266	
1.2	1121	1122	1124	1127	1135	1143	1154	1167	1182	1200	1223	1248	1274	1307		RP
1.4	1213	1212	1211	1213	1213	1220	1229	1240	1256	1273	1295	1318	1343			
1.6	1301	1295	1290	1280	1288	1292	1304	1313	1329	1345	1366	1388				
1.8	1383	1376	1367	1363	1363	1365	1376	1387	1400	1417						

DRIVE ASSEMBLY SELECTION

Since the RPM is now known, merely refer to the Drive Assembly Table. Select the RPM needed in the left-hand column. To the right of the RPM column are other columns indicating the number of turns open a specific driver pulley must be in order to deliver that particular RPM. Select whichever column gives the RPM desired. The driven pully, or fixed blower pulley, is selected from the extreme right hand column. V-belts are noted under each "Driver" column. To determine bore sizes of driver pulleys refer to the Blower Motor Chart for shaft dimensions. Bore size for all fixed pulleys is 3/4" for the AU0400 and 1" for the AU0500.

AU0400 DRIVE ASSEMBLY TABLE

RPM	Browning VL-44 Driver ½" or 5/8" Bore	Browning VM50-Driver ½" or 5/8" Bore	Fixed Blower Pulley-Driven (Browning AK56) 3/4" Bore
1025	3½ Turns Open	- Turns Open	All RPM Ranges
1058	3 "	- "	"
1092	2½ "	- "	"
1125	2 "	5 "	"
1157	1½ "	4½ "	"
1190	1 "	4 "	"
1224	½ "	3½ "	"
1257	0 "	3 "	"
1290	- "	2½ "	"
1323	- "	2 "	"
1356	- "	1½ "	"
1389.	- "	1 "	"
1422	- "	½ "	"
1455	- "	0 "	"
V-Belt	4L350	4L360	

RECOMMENDED SELECTION AREA IS NOT SHADED

AU0500 DRIVE ASSEMBLY TABLE

FAN RPM	Driver - Motor Sheave Browning VP50 (or VM50) X 5/8" (use w/3/4 or 1 H.P. motors)	Belt	Driver - Motor Sheave Browning VP56 X 5/8" (use w/1 or 1½ H.P. motors)	Belt	Driven - Fan Sheave Browning BK70
994	6 Turns Open	A	- Turns Open		All RPM Ranges.
1021	5½ "	A	- "		"
1048	5 "	B	- "		"
1075	4½ "	B	- "		"
1102	4 "	B	- "		"
1129	3½ "	B	- "		"
1155	3 "	B	6 "	B	"
1182	2½ "	B	5½ "	B	"
1209	2 "	B	5 "	C	"
1236	1½ "	C	4½ "	C	"
1262	1 "	C	4 "	C	"
1288	- "		3½ "	C	"
1315	- "		3 "	C	"
1341	- "		2½ "	C	"
1368	- "		2 "	C	"
1395	- "		1½ "	D	"
1421	- "		1 "	D	"

V-BELTS FOR AU0500			
V-Belts	A	5L420	Type V-Belts
	B	5L430	Type V-Belts
	C	5L440	Type V-Belts
	D	5L450	Type V-Belts

AU0400 AND AU0500 BLOWER MOTORS

H.P.	Serv. Factor*	NEMA Frame	Shaft Dia. & Len.	F.L.A. 115V	G.E. Model	Shpg. Wt.
Split Phase Motors - 1725 RPM 115/230V - 60 HZ - 1Ø (Class A)						
1/4	1.35	48Z	½" X 2¼"	5.2	5KH33FN15T**	15 lbs.
1/3	1.35	56Z	½" X 2¼"	6.0	5KH35JN30T**	18 lbs.
1/2	1.25	56Z	½" X 2¼"	9.0	5KH36MN22T**	23 lbs.
Capacitor -Start Motors - 1725 RPM 115/230 - 60 HZ - 1Ø (Class B)						
3/4	1.25	56Z	5/8" X 2¼"	11.6	5KC39UN7T**	30 lbs.
1	1.25	56Z	5/8" X 2¼"	14.6	5KC48TG726T**	35 lbs.
1-1/2	1.15	56	5/8" X 1-7/16"	21.0	6K324	39 lbs.

The above General Electric "Serv-S-Line" or Dayton motors are 1725 RPM, 115/230 Volt, 60 HZ, 1 phase, automatic reset, thermally protected types recognized by UL under the Motor Component Recognition Program. These motors are open, drip-proof type motors with Class "A" or "B" insulation, ball bearings, resilient base. The motor rotation can be reversed by reconnecting various electrical leads within the motor.

* Motors operated on 200 volts, 60 HZ will have a 1.0 service factor.

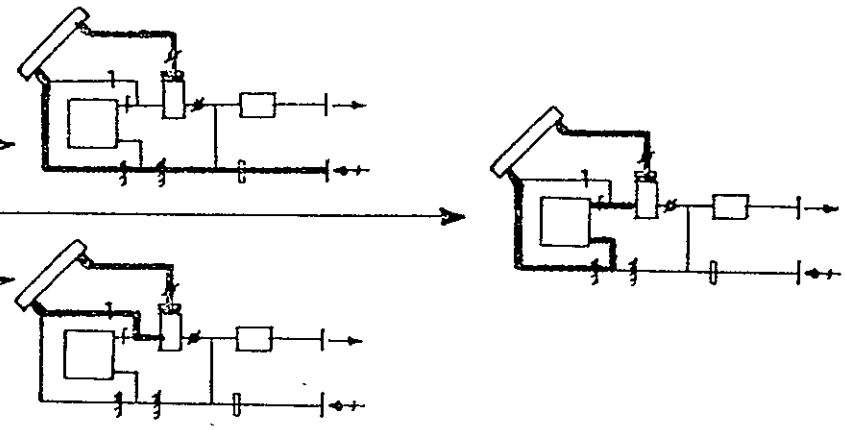
** Manufacturers producing motors of equal specification may be used. CLASS B MOTORS ARE RECOMMENDED FOR REPLACEMENT.

Selection Example:

Given: 312 ft^2 solar collector area (i.e. 2 high, 8 wide, vertical)
Solution: Air handler flow rate (2 CFM/ft^2)(312 = 624 CFM, round up to 625 CFM

The air handler motor and drive assembly must be selected to handle the external static pressure on the Solaron air handler. This selection should be based on the mode which has the highest static pressure drop. The possible modes are:

1. Heating from collector
2. Storing heat
3. Heating domestic water



The highest pressure drop for this example is #1, heating from collectors. The external static pressure drop for this is:

Return grille (see mfg. data)	0.05" w.g.
Return air filter (sized @ 300 to 350 FPM) (see mfg. data)	0.25
Backdraft dampers (2 each) (see A&E Manual pg. 89)	0.20
Collectors (2 panels in series, 2 CFM/ft^2) (see A&E Manual, pg. 80)	0.23
Domestic water coil (see this Manual, pg. 11)	0.08
*Ductwork (see below)	0.19
External Static Pressure	1.00" w.g.

Motor: 625 CFM and 1.0" external static pressure
RPM would be 1158 (see AU0400 Air Delivery Table)
This falls in the region for the 1/2 H.P. motor.

Drive Assembly: 1158 RPM is required at the 700 CFM point. Select 1157 RPM for the 625 CFM requirement. This RPM would be obtained with the driver: Browning VL-44 set at 1-1/2 turns open.

Blower Pulley: Would be Browning AK-56.

Summary: 625 CFM at 1.0" external static pressure

1/2 H.P. motor	Solaron #MT0050	
Driver VL-44	Solaron #DR0120	)
Pulley AK-56	Solaron #DR0120	) Package
V-Belt 4 L 350	Solaron #DR0120	)

*Ductwork: Static pressure drop through the ductwork is determined by the length and number of fittings. Solaron recommends that ductwork be sized at 0.08" w.g. pressure drop per 100 ft of duct. Fittings and elbows can be estimated by using 15 ft equivalent length of duct for each elbow with turning vanes.

The example above was based on:

(10 elbows)(15' elbow)	=	150'
Length of ductwork	=	90'
Total equivalent length	=	240'

$$(240\ \text{ft})\left(\frac{0.08"}{100\ \text{ft}}\right) = 0.192\ \text{w.g. pressure drop in ductwork}$$

DOMESTIC WATER COIL CAPACITIES

The Solaron domestic water coil is a 1-row copper tube coil.

Calculated coil capacities for size and CFM as listed: 1/2" tube, 10 FPI, one 1/2" inlet and one 1/2" outlet, aluminum fin stock .0055, copper tube .017", capacities based on 3 GPM, ENT. water 50°, E.A.T. 180°F.

AIR HANDLER	SIZE	CFM	FACE VELOCITY	WATER P.D. FT. @ 3 GPM	LV.W.	LV.A	BTU/HR.
AU0400	13 3/4 X 14	600	447	8.20	64.7	146.3	22,050
		800	597	8.20	67.0	150.7	25,500
		1000	746	8.20	69.1	153.7	28,650
AU0500	17 1/2 X 18	1400	642	13.40	80.7	151.7	46,050
		1700	780	13.40	83.9	152.6	50,700

NOTE: MINIMUM WATER FLOW IS 1.5 GPM

The Solaron domestic water heating option is designed to be used with pump #WP3060 (115/60/-Ø ---- .85 amp).

AU0400 - OPTIONAL DOMESTIC WATER HEATING COIL - PRESSURE DROP												
CFM	300	400	500	600	700	800	900	1000	1100	1200	1300	1400
Pres. Drop	.02	.03	.04	.05	.06	.08	.09	.11	.14	.17	.21	.25

Au0500 -											
CFM	1200	1500	1700	1900	2100	2300	2500				
Pres. Drop	.08	.09	.11	.14	.17	.25	.33				

GENERAL OPERATING PROCEDURE

FOR THE SYSTEM OWNER

SOLARON AU0400 AND AU0500 AIR HANDLERS

By simply adjusting the wall mounted thermostat you will be able to maintain a comfortably living or working environment.

By setting the switches located directly under the thermostat, and the sliding levers on top, you can select the type of operation you desire.

For winter heating set the top lever at the desired temperature that you wish to maintain. The thermostat will automatically operate the solar portion of your heating system as well as the auxiliary heating unit if conditions warrant its operation. Please do not "jiggle" the levers.

Should your space conditioning system feature cooling as well as heating, you merely move the switch underneath the thermostat to any desired position ("System Switch - Off - Heat - Auto - Cool). Locating the switch in the "Auto" position will permit the thermostat to automatically place the system in a heating or cooling mode of operation without further adjustment.

Space conditioning systems incorporating a heat pump heating and cooling auxiliary unit will have a thermostat switch position marked "Emerg. Heat". The only function of this switch is to provide emergency electric heat should the heat pump malfunction during a period of time when a serviceman is not readily available.

Nominal maintenance is required with this sytem. Please refer to "Maintenance Instructions" provided in the Installation Manual.

Please call your qualified Solaron serviceman should problems develop.

Installing Solaron Solar System Contractor

Name:_____

Address:_____

Phone:_____

The Solaron controller requires that its "Summer-Winter" switch be placed in the appropriate season position. When switching seasons it may be necessary to move some system dampers. Please have your installing contractor indicate these dampers to you.

Maintenance Instruction

The AU0400 and AU0500 require minimal upkeep for economical and long lasting operation.

Blower — Type 1 - Permanently sealed bearings - no oil required.

Motor — Type 2 - Blower Motor - Oil twice a year (#20 S.A.E. non-detergent oil).

Blower bearings - Permanently sealed - no oiling required.

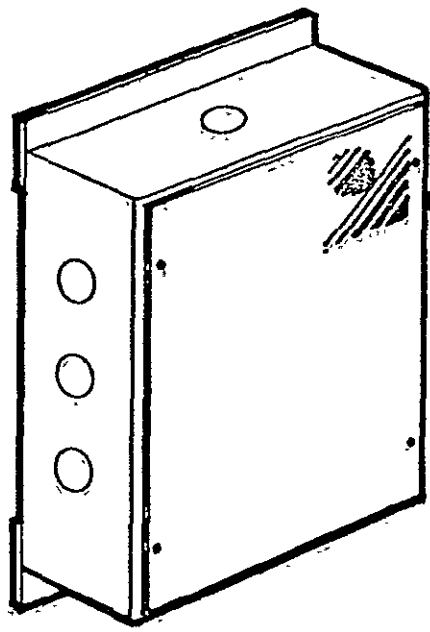
V-Belt - Check wear and tension, replace if necessary.

Damper Motors - Oil with #10 S.A.E. non-detergent oil (similar to #465 Anderol or Goodlight #10 oil.) Twice a year.

Water Pump - The Grundfos circulator pump requires no oiling as it is water lubricated during normal operation.

DO NOT RUN PUMP DRY

Installation, Operation, And Maintenance Manual



SOLARON™ Controller HC0116 & OFF PEAK CONTROL UNIT

FOR USE WITH AU0400& AU0500 AIR HANDLER

Applications:

HEAT PUMP

HEAT PUMP + OFF PEAK

Solaron™ Corporation reserves the right to make changes at any time, without notice, in materials, equipment, specifications, prices, models and design criteria, and to discontinue models.

SOLARON
SOLAR ENERGY SYSTEMS
·TM

SOLARON CORPORATION™
300 GALLERIA TOWER
720 SO. COLORADO BLVD.
DENVER, CO. 80222 (303) 759-0101

LOCATING THE SOLARON CONTROL PANEL AND TRANSFORMER

Mount the control panel in a convenient location that allows easy access for electrical wiring and "summer/winter" switch operation. Generally the mechanical room is the best location. Electrical service consisting of one 115 VAC circuit is ample to power the 100 VA, 120 VAC/24VAC transformer accompanying the control panel. Separate power circuits may be needed for the AU0400 or AU0500 unit and the auxiliary heating unit (refer to local and national building codes).

Low voltage wiring is needed to connect the Solaron space thermostat to the Solaron control panel as well as between the auxiliary heating unit, damper motors and the control panel. Damper motors are low voltage.

The thermostat MUST be wired through the Solaron control panel, it CANNOT be wired direct to the auxiliary heating unit and/or Solaron air handling unit.

SOLAR SYSTEMS SENSORS

Sensors must be properly placed in the following locations before system start-up can be accomplished:

1. Tco - Sensor must be in absorber plate air channel (not in duct connection or manifold plenum).
2. Tci - Locate at junction of house return air duct and duct connecting to bottom of heat storage (for systems with by-pass of heat storage for summer water pre-heating, locate in duct to collector where "by-pass" tees in).
3. Ts - Top of rock in heat bin.
4. Tw - Locate in bottom of water storage tank (not the auxiliary water heater) near inlet of heat exchanger coil. (If using an unwired electric water heater for a storage tank, the thermostat in the tank can be used as Tw. Disconnect power leads from thermostat and power element and wire through terminals that open on temperature rise - set @ 140^{0}F). Tw is field furnished (Honeywell L6006A1145 @ 140^{0}F and differential set @ 10^{0}F).

HUMIDIFIERS

Horizontally mounted type humidifiers are recommended. Locating the humidifier in a horizontal supply duct coming off of the auxiliary heating unit is ideal. Utilizing a sail-switch activated duct humidistat (similar to a Honeywell H49B) will simplify the wiring requirements of most installations.

DO NOT wire low voltage humidifiers or air cleaner relays in series with the thermostat wires (W_1 & W_2) as this can damage the Solaron controller. Sail or air pressure switches are recommended.

LOCATING THE THERMOSTAT

The Solaron multi-element thermostat should be located on an interior wall free from cold and warm drafts. Be sure adequate room air movement is present so the thermostat will provide a comfortable building temperature.

Do not locate the thermostat near lamps, heat outlets, stoves, refrigerators, television sets, etc. The heat given off by these appliances will not allow the thermostat to properly control the building temperature.

The thermostat heat anticipators should be set as follows: W_1 @ .10 amp, W_2 @ .10 amp. Cooling anticipators are non-adjustable.

SOLARON CONTROLLER AND THERMOSTAT LIST

AU0400 and AU0500 air handlers can be used in various applications.

Application	Solaron Controller Controller	Thermostat & Sub-base	Additional Relays Needed
Heat pump reversing valve energized for heating	HC0116	HC0022 HC0043	(2)#SR0225 Relays 1-AU0400 Blower 1-Dom. Water Pump
Heat pump reversing valve energized for cooling	HC0116	HC0023 HC0043	(2)#SR0225 Relays 1-AU0400 Blower 1-Dom. Water Pump

THERMISTOR TEMPERATURE/OHM RESISTANCE CHART

TEMP. C°	TEMP. F°	RESISTANCE OHMS	TEMP. C°	TEMP. F°	RESISTANCE OHMS
0	32	105,310	90	194	2,312
5	41	80,725	95	203	1,962
10	50	62,354	100	212	1,671
15	59	48,519	105	221	1,428
20	68	38,022	110	230	1,225
25	77	30,000	115	239	1,054
30	86	23,827	120	248	910.0
35	95	19,044	125	257	787.9
40	104	15,314	130	266	684.3
45	113	12,388	135	275	595.9
50	122	10,077	140	284	520.3
55	131	8,242	145	293	455.4
60	140	6,777	150	302	399.6
65	149	5,600			
70	158	4,651			
75	167	3,880			
80	176	3,251			
85	185	2,736			

The above chart can be used by the Solaron service technician to determine temperatures at Tco and Tci sensor locations.

To measure the resistance of a thermistor sensor disconnect both of its wires from the control panel (Tco & Com. or Tci & Com.). Measure the resistance using a good, accurate OHM meter. Once the resistance has been read it can easily be located on the above chart as well as the corresponding temperature to the left of the resistance.

The temperature difference between Tci and Tco must be $40^{o}F$ ($\pm 7^{o}F$) or greater to energize the "collector" relay. Should Tci & Tco leads be "crossed" the system will not operate under sunny conditions. Reversing the Tci & Tco leads will correct the problem. System will cease to collect solar energy when the differential drops to $25^{o}F$ ($\pm 5^{o}F$) or less.

HEAT PUMP
ENERGIZE F/HEATING OR COOLING

SOLARON CONTROL PANEL HC0116
WITH HC0022 OR HC0023 THERMOSTAT AND HC004 SUB-BASE

SEQUENCE OF OPERATION

I. SOLAR ENERGY AVAILABLE - when $40^{o}F$ ($\pm 7^{o}F$) differential is achieved between sensors Tco (in collector) and Tci (in return air duct - see specific plans), the following events take place:

A. Storing Heat - Room thermostat not calling for heat.

1. Differential thermostat in Solaron controller will activate "COLL" (collector) relay.

a. MD1 (motorized damper) - will be energized and powered open to allow air to flow to the inlet of the solar air handler blower (BWR), which is energized at the same time.

b. HWP (hot water pump) is also energized at this time if the Tw sensor (aquastat on water storage tank) is not satisfied (i.e. tank is less than $140^{o}F$).

c. MD2 (motorized damper) will be energized and powered closed to prevent air from flowing to the auxiliary heating unit.

B. First Stage Heating is called for by room thermostat - W_1 & R_H and sub-base system switch is set on "Auto" or "Heat".

1. "H1" (first stage solar heating) relay is energized.

a. "G" and "R" (fan auxiliary furnace) are energized, bringing on the heat pump indoor fan.

b. MD3 circuit is energized, closing the damper from its fully open position to its partially open or fully closed position (field balancing required).

c. MD2 opens as power through N.C. contacts in relay "HI" are interrupted.

d. Relay contacts close circuit to Ts sensor which is still in an open circuit via the "COLL" relay contacts position.

*C. Second Stage Heating is called for by room T-stat. First stage is still "made". If solar heat is available (i.e. "COLL" relay energized) when "H2" relay is energized, solar system will store heat while heat pump provides space heat. (OP1)**

1. "H2" (second stage auxiliary heat) relay is energized, completing the following circuits:

a. MD2 is powered closed.

b. MD3 is unpowered - opens full.

c. "R_C" circuit is completed to "Y" bringing on compressor in heat pump.

d. "R_C" circuit to "G" is still made keeping on auxiliary indoor unit blower. (OP1)

e. "R_C" circuit to "R3" is completed. No additional auxiliary relays are energized at this time.

D. Third Stage Heating is called for by second room T-stat (or outdoor thermostat). "R3" circuit to "W3" is completed, bringing on resistance electric heating elements in the indoor auxiliary unit ("R" to "W_1" circuit and "R" to W_2 circuit in HC0116 are "made"). (OP2)

E. "Emergency Heat" (to be used only if directed to do so by your service repairman, in the unlikely event of a heat pump malfunction). When the sub-base switch is put in this position the "Emergency Heat" relay will be energized.

The "EA" relay will complete the circuit between "R" and "E" allowing the indoor auxiliary unit to bring on the electric resistance heat when there is a call for heat from the heat pump (H2 energized). (OP3)

II. SOLAR ENERGY NOT AVAILABLE. When differential between Tco and Tci drops to 25°F (±5°F) or less, the following takes place:

A. "COLL" relay - de-energized.

1. HWP de-energized, pump off.

2. BWR de-energized, solar blower off.

3. MD1 de-energized and closed.

4. MD2 de-energized and open.

B. Circuit completed to Ts sensor if "H1" relay is still energized. If Ts sensor is above 90°F set point, system will heat space from heat storage unit. If Ts sensor is below 90°F set point circuit will be completed to "H2" relay and bring on the auxiliary heating unit without the need for the second stage of the T-stat to make.

III. Sub-base Switch Modes.

A. Fan - "On-Auto".

1. "Auto" position will permit auxiliary indoor unit fan to cycle on and off to meet the heating demands of the system.

2. "On" position will allow the auxiliary indoor unit fan to run constantly and allow MD3 (by-pass) damper to open fully, except when first stage heating is required.

B. Thermostat calling for Cooling (Summer Operation) System switch on "Auto" or "Cool".

***1. First stage cooling:

a. "R_C" circuit to "Y_1" is "made", on heating/cooling thermostat energizing reversing valve in outdoor unit (for units with reversing valve energized for cooling). (OP4)

b. "R_C" to "G" made; "R" to "G" made in HC0116 panel, brings on heat pump indoor unit fan.

2. Second stage cooling.

"R" to "Y" contacts close. Compressor circuit is energized to provide cooling. (OP4)

NOTES

* Heat Pump Systems with reversing valve energized for heating can generally be wired as follows:

HC0116 Terminal Strip	Heat Pump Terminal Strip Equivalent
Y	W_1
W	W_2
O	Y

** Numbers in parentheses refer to notes on alternate system operation when used in conjunction with the off peak control unit (page 57).

***Heat pumps where the reversing valve is not energized for cooling use only one stage of cooling.

DOMESTIC WATER HEATING

Switch "Winter" Position

Domestic water will be preheated anytime the system is storing heat or heating from collector.

Switch "Summer" Position

Domestic water will be preheated whenever enough solar energy is available to activate the system. When the stored water temperature reaches the set point of Tw sensor (about 140°F) the system will shut-down until the stored water temperature drops about 10°F.

ALTERNATE SYSTEM OPERATION WHEN HC0116 IS USED IN CONJUNCTION WITH THE OFF PEAK CONTROL UNIT

OP1 - In the off peak system a second stage call for heat will result in the system operating in either the heating from storage or heating from heat pump mode (see sequence of operation below modes 2 and 3).

OP2 - The R_3 to W_3 contacts in the HC0116 are made through a pole on the H32 relay, which in turn is energized by the third stage indoor thermostat.

OP3 - The EH relay will enable the strip heat to be used instead of the compressor. However, if there is a second stage call for heat the off peak control unit will cycle into mode 2, heating from storage, if possible.

OP4 - Refer to the Summer Operation in the sequence of operations that follow (modes 5 and 6).

OFF PEAK SUBSYSTEM SEQUENCE OF OPERATION

Winter Operation (November through March)

1. Storing heated water - When the time clock is in the off peak hours (10 P.M. - 8 A.M.), there is no call for second stage heating or cooling (H22 and C22 are de-energized), the ambient is above 2^{o}F (LA2 is de-energized), the off peak control unit switch is in the "HEAT" mode and the bottom of storage (T_{BOP}) is less than 130^{o} the system will operate in this mode. SH2 relay will be energized.

   a. The off peak pumps (OPP) will be energized.

   b. Motorized valves MV2 (coil bypass) and MV3 (storage bypass) will both be energized, bypassing the coil and allowing the tank in the flow loop.

   c. The compressor (Y) will be activated.

2. Heating from the storage tank - When there is a call for second stage heat (H22 energized), there is heat available in the tank (T_{SOPH} is greater than 90^{o}), no call for third stage heat (H32 de-energized) and the time clock is in the peak hours (8 A.M. - 10 P.M.) then the system will operate in this mode. HFS2 relay will be energized.

   a. The off peak pumps (OPP) will be energized.

   b. Motorized valves MV1 (a) and (b) and MV3 (storage bypass) will be energized. These positions allow flow from the top of storage through the heating and cooling coil and back to the bottom of storage.

3. Heating directly from the heat pump - When there is a call for second stage heat (H22 energized), and there is no heat in the storage tank (T_{SOPH}) is less than 90^{o}) or the time clock is in the off peak hours (10 P.M. - 8 A.M.) or there is a call for third stage heat, then the system will heat from the heat pump.

   a. The off peak pumps (OPP) will be energized.

   b. All motorized valves are de-energized.

   c. The compressor (Y) will be energized.

   d. If the ambient is below 2^{o}F, LA2 energizes at which point the compressor will be deactivated and the strip heat (W) will be energized instead.

Summer Operation (June through August)

4. Storing chilled water - When the time clock is in the off peak hours (10 P.M. - 8 A.M.), there is no call for second stage heating or cooling (H22 and C22 are de-energized), the off peak control unit switch is in the "COOL" mode and the top of storage (T_{TOP}) is warmer than 45^{o}, the system will attempt to store chilled water. SC2 and SC3 relays will be energized.

   a. All motorized valves will be energized.

   b. The heat pump reversing valve (O) will be energized.

   c. Provided the heat pump does not operate at a low suction pressure (53 psig) for more than 90 seconds, the LP2 relay will remain de-energized and both the compressor (Y) and the off peak pumps (OPP) will be energized.

5. Cooling from storage - When there is a call for first stage cooling but not second stage cooling (C12 energized and C22 de-energized), chilled water is available in the tank (T_{SOPC} is less than $55^{o}F$), and the time clock is in the peak hours (8 A.M. through 10 P.M.) then the system will operate in this mode. CFS2 relay will be energized.

   a. Motorized valve MV3 will energize allowing water flow from the bottom of storage through the coil and back to the top of storage.

   b. The off peak pump (OPP) will be energized.

   c. The reversing valve (O) will be energized but the compressor will not.

6. Cooling from the heat pump (chiller) - When there is a call for second stage cooling (C22 energized) this mode will operate.

   a. Motorized valves MV1a, MV1b will be energized.

   b. The off peak pumps (OPP) will be energized.

   c. The compressor (Y) will be energized. The reversing valve is already energized via the first stage (C12) cooling relay.

   d. If the suction pressure falls below 53 psig for more than 90 seconds the compressor and pump will be deactivated.

Spring/Fall Operation (September through November and April through May)

7. During spring and fall operation the off peak control unit switch will be set to "OFF". This position eliminates the possibility of the system operating in the storing heated water (mode 1) or the storing chilled water (mode 4) modes. After a few days the water storage will then return to the surrounding room temperature ($\sim 70^{\circ}F$) which will open T_{SOPH} and T_{SOPC} temperature controllers. This will eliminate the heating from storage mode (mode 2) and the cooling from storage mode (mode 5). Thus during spring and fall operation only modes 3 and 6 will operate.

Additional Controls

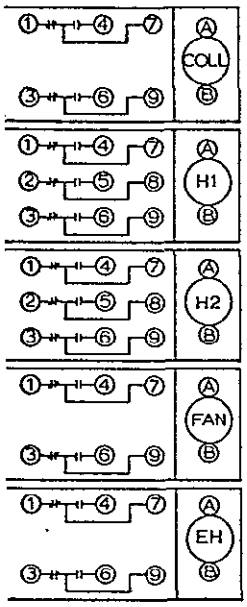
8. Defrost Control - If the outdoor unit senses a frost build up on the outdoor coil, the system will go into defrost. The DFT2 relay will be energized.

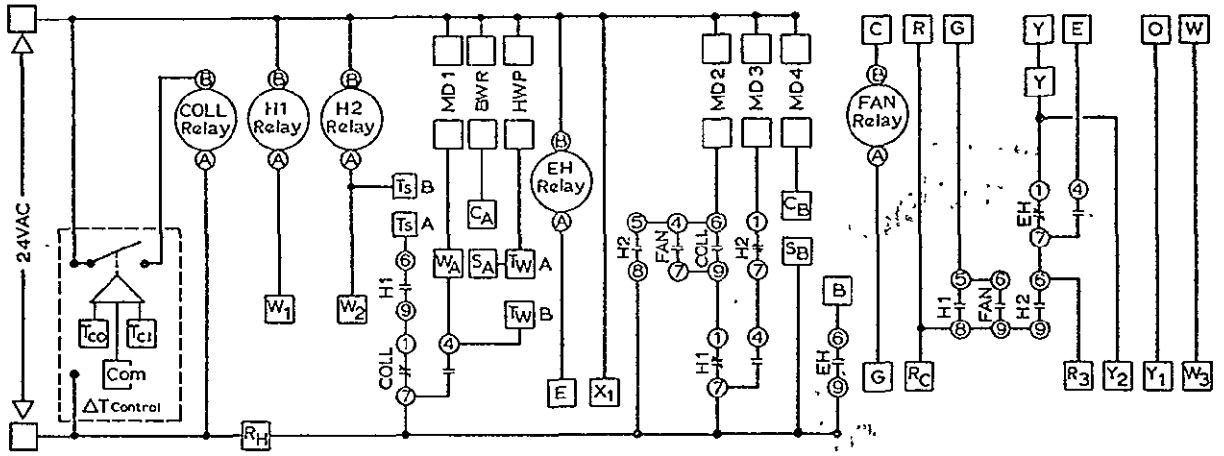
   a. The SC2 and SC3 relays will energize and the system will operate as in mode 4.

   b. If there is a call for second stage heating (H22 energized) the strip heater (W) will also be energized.

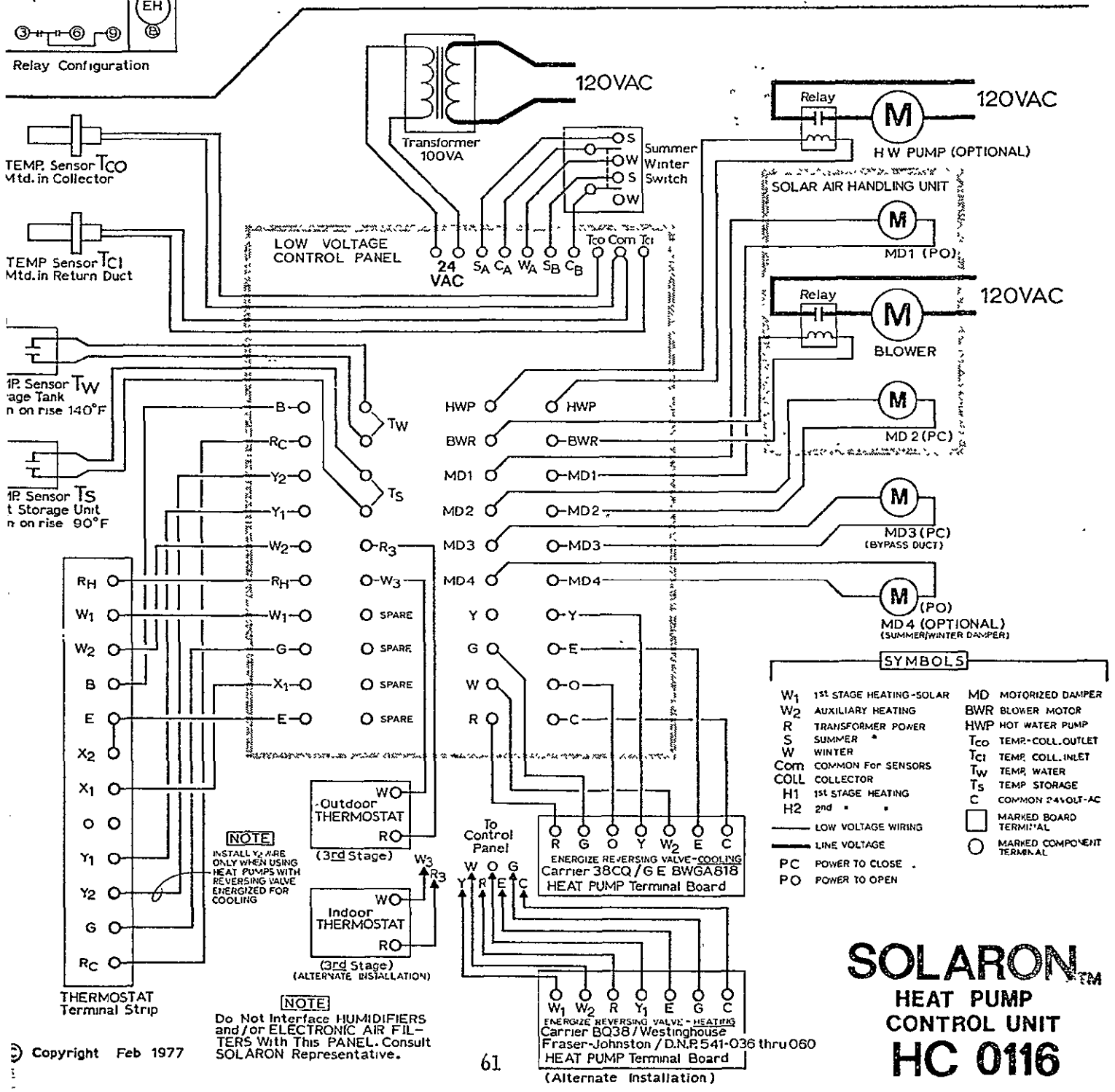
9. Low limit control - If at any point the temperature controller mounted on the coaxial heat exchanger (chiller) senses a leaving water temperature of less than $37^{\circ}F$ the compressor will be deactivated.

10. Water flow switch - If the water flow switch senses a lack of water flow, it will deactivate the compressor.





CONTROL PANEL SCHEMATIC



NOTE
INSTALL Y2 WIRE ONLY WHEN USING HEAT PUMPS WITH REVERSING VALVE ENERGIZED FOR COOLING

NOTE
Do Not Interface HUMIDIFIERS and/or ELECTRONIC AIR FILTERS With This PANEL. Consult SOLARON Representative.

SYMBOLS

W_1	1st STAGE HEATING-SOLAR	MD	MOTORIZED DAMPER
W_2	AUXILIARY HEATING	BWR	BLOWER MOTOR
R	TRANSFORMER POWER	HWP	HOT WATER PUMP
S	SUMMER	T_{co}	TEMP-COLL.OUTLET
W	WINTER	T_{ci}	TEMP. COLL.INLET
Com	COMMON For SENSORS	T_W	TEMP. WATER
COLL	COLLECTOR	T_S	TEMP STORAGE
H1	1st STAGE HEATING	C	COMMON 24VOLT-AC
H2	2nd " "		MARKED BOARD TERMINAL
	LOW VOLTAGE WIRING		MARKED COMPONENT TERMINAL
	LINE VOLTAGE		
PC	POWER TO CLOSE		
PO	POWER TO OPEN		

SOLARON™
HEAT PUMP CONTROL UNIT
HC 0116

GENERAL OPERATING PROCEDURE

FOR THE SYSTEM OWNER

SOLARON AU0400 AND AU0500 AIR HANDLERS

By simply adjusting the wall mounted thermostat you will be able to maintain a comfortably living or working environment.

By setting the switches located directly under the thermostat, and the sliding levers on top, you can select the type of operation you desire.

For winter heating set the top lever at the desired temperature that you wish to maintain. The thermostat will automatically operate the solar portion of your heating system as well as the auxiliary heating unit if conditions warrant its operation. Please do not "jiggle" the levers.

Should your space conditioning system feature cooling as well as heating, you merely move the switch underneath the thermostat to any desired position ("System Switch - Off - Heat - Auto - Cool). Locating the switch in the "Auto" position will permit the thermostat to automatically place the system in a heating or cooling mode of operation without further adjustment.

Space conditioning systems incorporating a heat pump heating and cooling auxiliary unit will have a thermostat switch position marked "Emerg. Heat". The only function of this switch is to provide emergency electric heat should the heat pump malfunction during a period of time when a serviceman is not readily available.

Nominal maintenance is required with this system. Please refer to "Maintenance Instructions" provided in the Installation Manual.

Please call your qualified Solaron serviceman should problems develop.

Installing Solaron Solar System Contractor

Name:_____

Address:_____

Phone:_____

The Solaron controller requires that its "Summer-Winter" switch be placed in the appropriate season position. When switching seasons it may be necessary to move some system dampers. Please have your installing contractor indicate these dampers to you.

Maintenance Instruction

The AU0400 and AU0500 require minimal upkeep for economical and long lasting operation.

Blower — Type 1 - Permanently sealed bearings - no oil required.

Motor — Type 2 - Blower Motor - Oil twice a year (#20 S.A.E. non-detergent oil).

Blower bearings - Permanently sealed - no oiling required.

V-Belt - Check wear and tension, replace if necessary.

Damper Motors - Oil with #10 S.A.E. non-detergent oil (similar to #465 Anderol or Goodlight #10 oil.) Twice a year.

Water Pump - The Grundfos circulator pump requires no oiling as it is water lubricated during normal operation.

DO NOT RUN PUMP DRY

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